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Health Aspects of Land-Fills

With Special Reference to Recent Experiences in New York City*

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THE prompt, scientific, and economic disposal of municipal refuse has for years occupied the attention of large municipalities here and abroad. As far as New York City is concerned, we need only mention a few of the specific attempts made during the past thirty years, all with varying degrees of failure to appreciate the great difficulty of the problem. Some of you may be familiar with the endlessly smoking Rikers Island dump, the smouldering Corona dump, the Barren Island reduction plant—spreading odors for miles in the neighborhood, the ill-fated Staten Island reduction plant—closed after a year's operation, and, finally, the disposal of waste by dumping at sea, which was discontinued 6 years ago by order of the United States Supreme Court.

For the past 3½ years, mainly two methods have been used by the city for the disposal of its refuse and garbage: (1) destruction by incineration, and (2) the sanitary land-fills. It is with the second and newer of the two disposal methods that this present paper will largely deal.

Before discussing the technic and health aspects of refuse and garbage disposal by land-fills, we want to point out that a recent, serious issue developed in New York City around the problem of garbage disposal by this method. The matter became a prominent health controversy before the city, challenging the various city departments and reaching up to Grand Jury indictments of the Commissioner of Health and the Commissioner of Sanitation. The question of the responsibility of the health officer and the powers of the Board of Health became issues involved in the situation.

Before the days of Koch and Pasteur, health officers and health departments devoted their time largely to environmental sanitation—the control of the smelly pig sty, the smoking dump, and the squalid tenement. These were matters of first importance, closely seconded by the damp cellar and the castoff wearing apparel.

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When, in 1877, Koch and Pasteur revolutionized our ideas on disease, our profession began to give its attention, and devote its activities to those things for which there was a scientific basis or experimental evidence. Gradually the health official turned away from many of the earlier fields because a relationship to health in its scientific sense could not be demonstrated. This was the period when bacteriology held sway and the effectiveness of our service to the people was strengthened and deepened.

In the last decade or so the pendulum has swung back again to include a much broader sphere of usefulness, resulting in a renewed interest in some of the traditional functions of the health departments. Housing, recreation, noise, and refuse disposal are related to health whether it can be scientifically proved or not. The public is right in demanding in addition to disease control, decent living conditions and opportunities for recreation. The program and responsibilities of health departments must be broadened.

With the expansion of health activities, cities and towns have come not only to have health departments, but also water departments, departments of public works, sewer departments, departments of sanitation, etc. In New York City the last mentioned has under its jurisdiction the collection and disposal of waste material, street cleaning, and snow removal. But, while such matters as water, waste disposal, and street cleaning are under the direct control of other municipal departments, the department of health is not relieved of the responsibility of supervising the public water supply, the disposal of sewage, or the collection of refuse—for the job of the health department and the body of laws which govern public health matters embrace all problems which pertain to the public health. The Board of Health, in the presence of great and imminent peril to the public health, can take such measures as are necessary for the preservation of the health of the people.

It is natural that the public should be sensitive to objectionable odors, excessive noise, dense smoke, unsightly and carelessly operated garbage dumps, and similar conditions. We will also agree that the public has a right to express itself plainly on such matters. Remedies against them are provided by our laws, and our Sanitary Codes make special provision for relief from "public nuisances." But the way to determine the existence of a nuisance is not by immediate appeal to drastic police power or court action, and, still less, by taking it onto the football field of politics; but through fact finding, group thinking, and scientific judgment. In our own case in New York City a group of citizens tried to remedy an alleged public nuisance by securing an indictment of two city commissioners—an unusual procedure. And yet, as a matter of fact, for the first time in New York City, a very serious effort was being attempted by city officials to develop a program of disposal of rubbish and garbage under sanitary, scientific control, that would be truly economical —cheaper than incineration.

The land-fill operations for disposal of these wastes involve an entirely different procedure from that used in the old refuse or garbage dumps that have been the community receptacles for its unwanted materials.

These modern land-fills are operated on an entirely different plane, with equipment of the latest design, and supervised by skilled and experienced men, with a better type of workman than has previously been used in such operations. The activity is no longer carried out by the dregs on the city pay roll and supervised by political drones, but is a serious business done by workmen who realize that

they have a responsible job and are expected to get real results.

In guiding and controlling the detailed operations, the facts of sanitary science, as far as available, are used, and where such scientific information is not available, experimental and research work is carried on. The Commissioner of Sanitation has appointed an advisory group of sanitary scientists and public health officials, and an extensive WPA research project on land-fills has been sponsored by that department. This project is under the supervision of the Division of Sanitary Engineering of New York University. As many of you may recall, a preliminary report on the work of this project was presented by the late Professor Carpenter and Professor Setter, at our Pittsburgh meeting.[1]

As a result of this type of controlled operation of the land-fills, there was developed during the last 3½ year period a procedure for handling these wastes, which provides a nuisance-free land-fill which is in no way to be compared to the refuse dumps of the past. The procedure prevents fires, eliminates rat breeding, minimizes the fly nuisance, permanently takes care of previous mosquito breeding areas, and avoids objectionable odor nuisances.

Keeping in mind the problem of economic hauling distances, low-lying mosquito-breeding marshlands, not too close to habitations, are selected for these land-fills. Here, preliminary preparations are made, staking out the areas and elevations for the work. The first operation is to bring in dragline excavating machines with a 70 to 80 ft. boom, to excavate soil and sand to be placed in stock piles for subsequent use as covering material.

The refuse, brought in by large, self-emptying, covered collection trucks, is discharged into these low or excavated areas. The material is a mixture of miscellaneous city rubbish in which is included from 3 to 10 per cent of household garbage and food refuse. Tractor bulldozers weighing 19 tons level off and compact this material. At the end of each day's dumping operation, a 6 in. soil or sand cover is placed over this material. A raw edge slope of limited extent is exposed only sufficient to allow for subsequent operations at the fill. When the fill reaches the desired grade, a sealing cover of 2 ft. of sand or soil is added. Special emphasis is put on the importance of adequate covering material properly applied on the surface and the face of the fill. As an added precaution there also might be a sand filled boundary trench at the base of the slope.

As the operation proceeds, the sloping edge of the fill is given as much consideration as the top, to prevent rat harborages, fires, or fly nuisance. Where the slope of the fill ends and the marsh begins, it has been found good practice to provide a clean sand seal of several feet thickness, which will prevent rodents that harbor in the marshes from burrowing and locating new homes in the refuse land-fills. A 6 ft. snow fence is maintained around these dumping operations, to trap paper and litter that may be blown away from the fill. There have naturally been questions raised as to the presence of disease-causing bacteria which may present a health hazard. The question has also come up whether the gases produced by fermentation may give rise to spontaneous combustion or odor nuisances. These matters have been studied by the technical advisory committee, and by the WPA land-fill project to which we have previously referred. No indications of such hazards have yet been shown, and practical conditions confirm this point of view.

This plan has made possible the reclamation of substantial areas of lands hitherto unfit for use, which are now quite adequate for parks, playgrounds,

Discharge of Garbage and Other Wastes from Trucks on Dumping Front—Refuse Disposal by Land-fills

Dumping of Wastes Along Working Front—Initial Earth Cover Placed After Compacting—Refuse Disposal by Land-fills

Compacting of Material by Bulldozer Tractor and Spread of Cover Material—Refuse Disposal by Land-fills

Completion of Grading and Covering—Refuse Disposal by Land-fills

air fields, and, in all likelihood, for ordinary building structures. Acknowledgment should here be made to the Sanitation Department and Commissioner William F. Carey through whose vision, energy, and enterprise this modern, scientific engineering project was made possible.

In New York City, the Sanitation Department is disposing of 9,000,000 cu. yds. of refuse and garbage per year through the use of land-fill. That department has completed 5 land-fills and retrieved for useful purposes a total area of 325 acres. It is now working in 10 additional areas, which, when completed, will reclaim 1,000 more acres. The complete cost of disposal of waste by land-fills has been 7½ cents per cu. yd. as against 30½ cents per cu. yd. when incineration is used. In addition, the land-fill method provides for greater economy of use of equipment and less investment in fixed plants, and avoids some of the other problems with incinerators, such as smoke, fly ash, and local objection to the permanent structures.

We have no intention of condemning well operated incinerators as a method of disposal of these wastes. However, we do wish to point out that a properly conducted land-fill procedure is more economical, can be carried out with as little inconvenience to the public as incinerators, and is better adapted in a good many ways to the situation in our city. By disposing of 4,000 truckloads of waste material daily through land-fills, the Department of Sanitation has been able to close up 11 of the smaller and less efficient incinerators out of the total of 22 incinerators formerly in operation.

It may be stated here that a very similar method of disposal of refuse has been receiving prominent attention and widespread use in recent years in England, where it is known as "controlled tipping." This method has been the subject of organized scientific research, particularly at Manchester, and the extensive report of the experimental test carried out at that place in 1932 and 1933 produced the following conclusions: The disposal method of "controlled tipping is definitely sound and safe"; that it is "highly improbable that disease-causing pathogens can multiply or continue to live within any tip . . . there is no more reason to acquire undesirable bacteria during a stroll over an area where controlled tipping is taking place than it is by taking a walk along a field path in the country or when working in his garden"; that "there is no explosion hazard nor are the gases odorous." This disposal method has received recognition of the British Ministry of Health, and has recently been employed for the disposal of about one-sixth of the municipal refuse dealt with in England and Wales. In this country, a method of land-fills has been very successfully used for the past 5 years by the city of San Francisco, and has also been employed by Fresno, Calif., Portland, Ore., Tacoma, Wash., and other places.

We would like now to return to the New York City court action matter. When groups of citizens began sending to the Health and Sanitation Departments general objections to the land-fill operations, we had regular inspection visits made by representatives of our two departments, and also called upon sanitary and health experts who were available in our vicinity to make inspections and give us their opinions. We became convinced that these land-fills did not result in a nuisance nor endanger health, and that they were thoroughly justified in the interest of economy to the city. Nevertheless, pressure was brought repeatedly to bear on city authorities to discontinue entirely all these dumping operations. This was followed, as stated, by the indictment of the Sanitation Commis-

sioner and the Health Commissioner, on the grounds of maintaining public nuisances and failing to act and cause the abatement of public nuisances, allegedly caused by operation of city land-fills.

In due course, the case came up for trial at which time an agreement was reached between the District Attorney, and the Corporation Counsel, with the approval of the Court, whereby the indictments against the City Commissioners were dismissed and the entire issue, namely, whether such land-fills constituted public nuisances or endangered the public health, was referred to a committee of experts to be appointed by Surgeon General Thomas Parran of the U. S. Public Health Service. The members of the committee as appointed by Dr. Parran included the following: Dr. M. J. Rosenau, Dr. E. L. Bishop, Dr. Huntington Williams, Dr. Kenneth F. Maxcy, and R. E. Tarbett.

The final report of these experts, which was issued in March, 1940, gives, we believe, a reasonable and correct answer to the question, "Do land-fills endanger the public health or safety?" Their answer was, "No."

In the opinion of this group—

> There are no conditions presently obtaining at the 5 land-fills which endanger the public health or safety. On the contrary, the committee is convinced that certain potential public health hazards obtaining previously at the sites of these fills have been diminished, for filling is one of the best methods of controlling rats and mosquitoes in marshes and swamps.

The committee furthermore states:

> We realize that an ideal method for the disposal of wastes of a large city has not yet been evolved, and that methods must of necessity vary with local conditions. Moreover, the choice of a method is influenced by considerations of administration, efficiency, and economics. We are not asked to pass upon such considerations. Likewise, we are not asked to determine whether the sanitary or regulated land-fill is the best method which could be used in the Borough of Queens. The committee is asked in the stipulation to answer specific questions as to whether there are any conditions presently obtaining, or to be expected in the future, which might endanger the public health or safety at the 5 land-fills mentioned.

Not only has the principle of public health been vindicated, but by this method of adjustment of the issue, the public has benefited, as the following recommendations made by the committee will show. The committee, however, in making these recommendations, did not intend to imply that the procedures recommended were not being followed in whole or in part. Here are some of those recommendations:

> 1. The disposal of wastes by the land-fill method should be planned as an engineering project. Operation and maintenance should be under the direction of a sanitary engineer.
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> 5. Waste building material, concrete or other bulky waste material which may furnish rat harborage should not be used for the final surface or side slopes, but should be promptly incorporated within the fill.
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> 6. The final covering for surface and side slopes should be maintained at a depth of approximately 24 in.
>
> 14. Inspection for and control of rodents should be maintained until the fills are stabilized.
>
> 15. After the active period of filling operation is completed, a maintenance program should be continued until the fill has become stabilized so as to insure prompt repair of cracks, depressions, and erosion of the surface and side slopes.
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> 16. Studies of the varied problems involved in land-fill operations should be continued and should include researches into the biological, chemical, and physical activities, as well as the engineering, economic, and administrative aspects of the subject.

NOTE: Comments on the committee report and some of the recommendations are given in a news item in this journal, see *A.J.P.H.*, 30, 7:850 (July), 1940.

Other recommendations related to such matters as maintaining narrow working faces on these fills, prompt covering of exposed surfaces with earth to make a closed cell of each day's deposit, covering of surface and side slopes with earth to a depth of 24 in.,

termination of boundary side slopes in a sand and gravel-filled ditch, spraying to lay dust, restricting the packed refuse layers to a depth of about 8 ft., and maintenance of water under pressure for fire fighting purposes.

A direct result of this experience with land-fills has been a much improved disposal procedure for refuse; public health practice has been strengthened by the decision that health experts rather than courts decide such issues.

REFERENCE

1. Carpenter, Lewis V., and Setter, Lloyd R. Some Notes on Sanitary Land-fills. *A.J.P.H.*, 30, 4:385 (Apr.), 1940.

Public Health Engineering Aspects of Epidemiological Investigations of Water- and Food-borne Outbreaks*

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IT is a well established fact that the investigation and control of an outbreak of disease of any considerable magnitude, whether it be in a community, an institution, or a single building, calls for a high order of team work. The services of individuals representing a general cross-section of the activities of a well balanced public health organization may be called upon before such an outbreak is brought under control and its cause or causes established beyond a reasonable doubt.

This paper is directed particularly to public health engineers in the hope that it may serve to indicate a broader conception of their responsibilities in dealing with outbreaks of disease, especially in regard to the application of engineering knowledge and experience in environmental sanitation, and possibly to point a way to more comprehensive coverage of their assignments. It is also offered with the thought that it may suggest to epidemiologists in charge of investigations more effective ways by which engineers and the engineering viewpoint might be used to help them in interpreting the significance of the large amount of data usually collected in the investigation of an epidemic.

The rising importance of water as a medium of transmission of diseases other than typhoid fever and gastroenteritis is emphasized by the fact that in recent years water has been the cause of, or under strong suspicion as having been involved in, the transmission of several diseases which a decade or more ago were not generally considered water-borne—at least in epidemic form, namely: amebic dysentery (Chicago 1933); epidemic jaundice (Smolan, Kansas 1935, and Burney, California 1939); tularemia (Russia 1935; *Bacillus tularense* was found in three streams in Montana 1939); undulant fever (Michigan State College 1939); poliomyelitis (Long Island 1931).

There is also evidence of an increasing number of food and milk-borne outbreaks in such institutions as schools, hospitals, jails, asylums, industrial plants, camps and summer resorts. Infections by organisms of the Salmonella group seem to be most common with *Salmonella aertrycke* often the causative agent. Furthermore, a number of outbreaks of illness characterized by sudden onset, nausea, muscular pains, cramps, projectile vomiting, absence of fever, and rapid recovery—within 24 hours—have also been reported, for which the true etiologic agent has not been found.

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In water-borne epidemics and to a lesser degree those involving milk and other foods, the impelling forces which start the outbreaks and the various avenues by which infection is spread are often so deeply rooted in the environmental aspects of community life that their discovery and the determination of their true relationship to the epidemic may require a most painstaking investigation, coupled with special knowledge of local conditions and operations. Here the alert public health engineer often can be of real service to his colleagues in the investigation, particularly if he is called during the early stages of the outbreak and is kept informed of developments.

Epidemics have a negative as well as a positive phase. The positive phase may be defined as that related to the spread of infection and is indicated by persons made ill or found to be infected; the negative phase is that related to the paucity or absence of infection and is generally indicated by non-cases. Frequently, clews as to the cause of an epidemic, which are difficult to follow in the positive phase, may readily be developed from the negative phase. This is especially true if environmental factors are involved. When the correct solution is found, the positive and negative evidence should complement each other, presenting a complete story of the epidemic. This happy condition is the goal of all investigators —one rarely attained and not infrequently barely approached.

Given the proper chronological and statistical picture concerning an outbreak, the experienced public health engineer can intelligently explore possible avenues of infection related to the environment and normal or abnormal operations of a community, institution, or home. He can evaluate his findings in the light of the epidemiological facts assembled, and assign each, if involved, its proper place in the chain of events which lead to the outbreak. There must be an unraveling of related factors with nice discrimination in the elimination of nonessentials. However, details must not be overlooked, as among them leads to valuable evidence may be found. The investigator must expect to backtrack his trail many times as "dead-ends" or what appear to be such are encountered.

Once the onset diagram for an epidemic is charted and adjusted for the incubation period, the time that infection first became widely disseminated usually may be established within reasonable limits. But an investigation must go much deeper than this; it must establish the source and type of infection, and the circumstances which released it to strike the afflicted community. In typhoid fever outbreaks, bacteriophage typing of the organism, as used in the Los Angeles epidemic of 1939, gives the epidemiologist a new tool to work with.

Not infrequently the specific factor which suddenly cleared the way for infection to travel from person to person was the resultant and cumulative effect of some indirect and distant force set in motion days, weeks, or even years before an outbreak began. Therefore, in considering possible circumstances surrounding an epidemic from the environmental viewpoint, one must often consider cause and effect both in the foreground and in the long perspective of time. For example, the wooden plug which was driven into the overhead sewer pipe above the drinking water storage tank in the basement of the Congress Hotel, in Chicago, where the famous amebic dysentery epidemic of 1933 occurred, undoubtedly had served many years as an effective plug, before advanced decay of its fibers made leakage possible, and started one of the most notable water-borne epidemics of modern times.

As a further example, the writer

knows of a case where an iron bulkhead improperly set by a diver in 1900 permitted leakage of more or less polluted shore water into a water tunnel for nearly 23 years before a combination of circumstances developed to permit mass infection to pass through the opening around the bulkhead at a time when chlorination was apparently inadequate, and thus cause a major typhoid fever outbreak.

Many outbreaks where water or food is involved are the culminative effect of several forces acting simultaneously. One or more of them may have acted for years without causing infection to spread, but sooner or later as the wheels of chance roll, the "jack pot"—little or great—will be struck and precipitate an epidemic. The public health engineer who is to be successful as an engineer-epidemiologist must train himself to look for the resultant effect of a variety of potential causes, and must consider the long term as well as the immediate action of each.

In investigating water or food outbreaks, the public health engineer should always seek evidence of abnormal conditions or operations in or related to the affected area. This may begin with such general environmental items as abnormal weather conditions and continue on down to the most detailed duties or habits of operating personnel at a plant or institution.

If water is involved, the public health engineer early in his investigation should assemble the facts concerning meteorological conditions in the district or region involved. Because of the highly infectious character of sewage, items affecting its removal and disposal should be given special attention. Excess rainfall may mean surcharged sewers, abnormal operation of sewage pumping equipment, excessive pressures in sewers, or the use of overflows and by-passes. In buildings the operation of sump pumps or air ejectors should be carefully checked. Drought may lower ground water levels, deplete normal sources of supply and necessitate the use of others. Freezing weather may cause broken mains or clog intakes resulting in the use of emergency intakes. Changes in barometric pressures may develop seiches on lakes, causing sudden "turnover" with depletion of oxygen in the lake water and often a sharp increase in its chlorine demand properties, thus lowering the disinfecting value of the chlorine applied. A wind storm may cause a tidal wave with destructive force flooding plants and equipment; or it may cause the sudden drift of pollution toward water intakes normally at a safe distance from sources of contamination. Excessive heat or high humidity might result in such a heavy demand for water for sprinkling or air conditioning as to reduce pressures to a point where negative head may occur periodically in the upper parts of the distribution system. Low pressures in localized areas might necessitate repumping of water within plants or buildings direct from the public main, causing negative pressures in pipes connected to the suction side of the pump.

Abnormal operating conditions in a community, such as a large fire, an explosion in a sewer or plant, an interruption of power, a main break, a surge in a tunnel, water hammer in mains, or the erroneous closing of important valves in the system, may have a direct or indirect effect on the chain of circumstances that bring about a water-borne outbreak.

In large modern office buildings, schools, hospitals, hotels, industrial plants, and institutions, the population is frequently larger than in many well organized cities; yet the supervision over service to the public often may be inferior to that which might be exercised in even a small town. Sometimes just the reverse is true. In some cities

where the water supply is not filtered, it is common practice in large buildings and institutions to filter the water in pressure filters and to soften that used for washing and laundry purposes. Where chemical treatment of the water is provided for, care must be taken to see that the chemicals are used correctly, and that they are stored in containers which are properly marked, so that mistakes in use will be avoided. Water treatment chemicals should be kept separate from all other supplies, and preferably under lock and key. It is not uncommon in some buildings to find boiler feed water chemicals, radiator anti-leak compounds, calcimine, cold water paint, washing powder, insecticides, rodent poisons, fertilizers, etc., stored in miscellaneous cans, barrels, and bags in the same room in the basement under conditions where mistakes in identity and use could easily be made. Not infrequently the same shovel or scoop may be used in handling a variety of such chemicals.

Operating details such as changes in personnel during shifts, vacations, or relief periods deserve careful checking. The day and even the hour when infection was let loose may sometimes be established from a close scrutiny of operating details, particularly such records as hotel or hospital admissions and releases, school absences, meal menus, order books, operating logs, diaries, recording gauges of all kinds, sales slips, and drug prescriptions. Even seemingly insignificant records and events in the community or institution which account for the presence of persons ill, or the absence of persons not ill, from the probable place of infection may prove invaluable in establishing evidence. For example, in investigating a water-borne outbreak of considerable magnitude which followed a great mid-western fire a few years ago, the exact time when chlorination of a grossly polluted water supply stopped was established from the chart of the recording pressure gauge on the discharge of a pump.

When a plant has been shut down for an extended period and is then put in service again, or when it has been remodeled for new tenants, some changes in water supply and sewage piping are almost sure to be made. If an outbreak of illness occurs under these conditions it is well to investigate such possibilities. New operating personnel in old plants are likely to make changes in piping and plumbing without giving due consideration to potential hazards unknown to them.

In institutional and building outbreaks, local operating practices and plant layouts must be investigated very carefully. Altogether too often members of the operating and maintenance staff may make radical changes in the plant service or utility systems without giving proper notification to other responsible officials or tenants, with the result that while normal institutional functions are being carried out, essential services are unexpectedly shut off or reduced. Not infrequently, this lack of coördination will cause conditions to be established which jeopardize the public health. In a hospital, the shutting down of a steam plant for repairs might seriously affect the steam sterilization of instruments for an emergency operation. In a bakery or kitchen, interruption of sources of heat, whether gas, electricity, or steam, might seriously affect cooking procedures, permitting foods presumed to have been sterilized by cooking to be under-heated or possibly kept at temperatures favoring bacterial growth. Food in storage may be affected by the shutdown of refrigeration equipment for repairs.

There is, however, another side to this situation. In many institutions, such as hospitals and hotels, funds for equipment and maintenance are allotted liberally to those services which can be seen by the public, but are grudgingly

granted for proper maintenance and recording equipment in such important service departments as the power plant, laundry, kitchen, and building maintenance. This is a decidedly short-sighted policy. It is obviously ridiculous to spend money on lavish equipment in a hospital operating room and then neglect proper maintenance of the steam, water supply, or lighting services, so essential to the proper operation of the hospital.

In any well managed plant, the chief operating engineer should keep a daily log of all equipment in service, including such recording devices as are essential to efficient control, such as pressure gauges, meters, weighing devices, and thermometers. Information from these sources is not only important for good operation, but is of inestimable service in investigating food- or water-borne outbreaks.

In institutional outbreaks the sex, age, occupation, lodging houses, and place of work, meals, and recreation of persons made ill, as contrasted with those not ill, may provide important leads which can be coördinated with known operating practices to establish evidence which will help solve important epidemic problems. For example, if cases of illness in a school, hospital, or institution are all on one floor or in one wing, this fact may be of real significance if the outbreak is water-borne. Cases on upper floors are suggestive of contamination through back siphonage, because as a rule negative head is created in the upper section of the piping. Cases confined to one section or wing of a building direct suspicion to conditions related to one or more local riser pipes serving that area. If water is involved, and cases are generally distributed throughout a building, the contamination is more likely to be at the source of supply or at a point before the system branched off to various parts of the plant.

If plumbing fixtures are supplied by "up-feed" piping, the hazards related to back siphonage are much more serious than with "down-feed" systems. In the former the water pipes for plumbing fixtures on a given floor take off from the header near or above the ceiling of the floor below and feed upward; in the latter, they take off near the ceiling of the respective floor supplied and the feed is downward. In the "up-feed" system it takes but a slight negative head to cause back siphoning of polluted water from fixtures with submerged inlets into the main supply header, whereas in the "down-feed" system a negative head of many feet must obtain before serious contamination of the water supply of the building can occur.

A few years ago, in investigating an outbreak of illness in a large mid-western grammar school, the writer was attracted by the fact that all of the reported cases were among pupils in three or four rooms near the end of a corridor on the second floor of the building; also that the case incidence was over 50 per cent higher among girls than boys, although in these rooms the distribution of pupils by sex was about even. Near the end of the corridor there was a drinking fountain just outside the door to the girls' toilet room. This directed suspicion to the water system serving the toilets and the drinking fountain. It was found that they were supplied from the same pipe in an "up-feed" system; also that the toilet bowls had side-spud connections with submerged inlets and flushmeter valves. It was the practice in this school to drain the water system completely over each week end during the winter months to prevent freezing of pipes.

Suspecting back-siphoning of fixtures when the water system was drained, a special test was conducted. A strong chlorine solution was poured into each toilet bowl and the water level marked.

The janitor was then asked to drain the system in the usual week-end manner. Within a fraction of a minute after he opened the basement drain, an 18 inch vacuum was recorded on a compound gauge installed on the water line, and the water level in the bowls dropped nearly an inch. Samples of water collected from the drinking fountain and tested for excess chlorine with orthotolidin, showed a brick red color where previously only a pale yellow color had developed. This was clear proof that the week-end practice of draining the water system could cause siphoning of the girls' toilets and gross contamination of the drinking fountain.

Attempts to repeat these results at a similar fountain outside a boys' toilet in this school failed, and no vacuum was recorded. The reason was found in an "over-the-top" connection to an automatic flushing tank for a battery of urinals. This open connection served as a vacuum breaker on the water system to the boys' toilets.

In food-borne outbreaks it is of prime importance that all foods under suspicion be impounded promptly and that sample be collected for such laboratory analyses and research work as circumstances indicate to be desirable. Foods shown by analysis to be safe can be usually released for use within 48 hours. In the meantime, the use of food supplies from a new source should not cause inconvenience out of proportion to potential risks involved in continuing the use of normal stocks under suspicion. The day and meal the alternate food supplies were substituted may later prove to have very important epidemiological significance.

In food-borne outbreaks the public health engineer should check promptly all equipment and utilities used at the place under suspicion. He should also acquaint himself in detail with all operating practices with reference to the use and maintenance of this equipment. The water supply, plumbing, and drainage facilities should be investigated thoroughly as in the case of a waterborne outbreak. Refrigeration plants and equipment—especially if ice is manufactured below grade—should be checked for exposure to contamination by overhead drains or backflow from sewers. Garbage and refuse disposal methods should be carefully checked.

Structural defects which permit infestation of the premises by rodents, vermin, and insects may be very important factors. Heat control and recording mechanisms on stoves, ovens, dishwashers, pasteurizers, and similar equipment should be checked and calibrated for accuracy. Storage rooms for supplies should be investigated to determine whether or not they are subject to overhead contamination or flooding, and to see that food is not stored directly on the floor. Tables and racks where food is prepared and served, or where dishes and utensils are stored, should not be directly below sewer lines, drains, or sprinkler heads. Warming trucks and steam tables should be examined for cleanliness and location with reference to exposure to contamination.

It would be well to check all open containers in rooms where food is prepared, to see that no poisons are handy which might be mistaken for flour, sugar, or salt. It is a common practice of cooks and bakers to use quart and gallon tin cans for convenient retention of salt, sugar, flour, meal, washing compounds, and even insecticides. Identifying markings on the cans are the exception rather than the rule. Under such conditions a new assistant or utility man might carelessly mix poisonous substances with edible products in the preparation of food.

Poisons of all kinds should, of course, be kept out of kitchens and bakeries, and if insecticides must be used one of the Pyrethrum powders or solutions should be obtained.

Anyone who is investigating a food-borne outbreak would do well to act as an observer of the normal operations of employees in the kitchen, pantry, bakery, or other place under suspicion, and take detailed notes of the practices of the various employees. In difficult cases this may be a very important assignment. In terms of potential hazards the practices of such employees may prove a revelation. For cleaning purposes, elbow grease, hot water, and soap are much to be preferred to scraping and excessive use of covering materials, paint, and chemical disinfectants.

Milk and dairy products should if possible be purchased in containers so sized that once opened the contents will be consumed rapidly. Storage of any food products in open containers should be discouraged as much as possible. Ice should be handled and stored under hygienic conditions. Every effort should be made, if possible, to keep ice out of direct contact with food and drink. In hospitals where ice may be used in packs and oxygen apparatus, it must be so stored in the wards that this same supply of ice will not be used to cool drinks.

CONCLUSIONS

1. It is evident that the rôle and responsibilities of the public health engineer as a team worker in the investigation of water- and food-borne outbreaks of disease, especially from the standpoint of environmental sanitation, is an important one, possibly more so than is realized by public health engineers and epidemiologists.

2. The widening importance of water in the transmission of disease is indicated by the fact that, during the last decade, it has been reported that water was involved or under strong suspicion as the vehicle of transmission of the etiologic agent in outbreaks of amebic dystentery, epidemic jaundice, tularemia, undulant fever, and poliomyelitis, not previously considered as water-borne diseases.

3. In investigating outbreaks of disease from the environmental standpoint, the public health engineer serving as an engineer-epidemiologist, must be fully informed as to the chronological and statistical aspects of the epidemic, and then seek to interpret environmental conditions and operating practices in the area affected, as they may have a bearing on the epidemic.

4. Possible contributory causes of food- and water-borne outbreaks must be considered in their long-term cumulative effects as well as their more immediate influence; and consideration must be given to the fact that an outbreak in a community may be the resultant effect of multiple hazards which merely awaited a precipitous circumstance to become operative.

5. There is need for a more thorough "follow through" of water-and food-borne outbreaks, especially in establishing a clear case as to the avenues through which infection was transmitted; altogether too often lack of such evidence is due to inadequate or incomplete investigation of environmental conditions for which service the public health engineer is especially qualified and, therefore, has a real responsibility properly to perform.

Are we public health engineers measuring up to this responsibility?

A Restatement of the General Hospital Situation*

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IN recent months, as doubtless all of you well know, a hospital bill has been written up and started through the legislative process. Whether this particular bill survives or falls by the Congressional wayside, it is more than likely that one day we in public health shall be seriously undertaking the task of equalizing the hospital facilities among the regions and among the people of this nation. Last winter, in preparation for hearings on pending legislation, the U. S. Public Health Service canvassed the health officers of the country for their opinion as to the need for additional hospital facilities.

Their replies offer an interesting commentary on their practical understanding of the extent and use of hospital facilities of different types.

On the whole, the health officers took the statistical approach in reporting on tuberculosis beds. Starting from available beds and reported deaths, they made careful estimates of the facilities required for their potential patient load. They also took into account the possible effects of an aggressive case finding program upon their estimates. They considered the trend in tuberculosis mortality and trimmed their forecasts accordingly. In their recommendations they went into detail as to size of unit, location of unit, type of construction, and so on.

These health officers also revealed themselves as informed on that all important point of finance—the amount of money required for constructing and operating added facilities. They were not at a loss as to the sources from which such funds might be obtained. All in all, they turned in a good performance.

It does not detract from that performance to say that the stubborn fight of several generations of crusaders against tuberculosis has helped to produce this attitude of practical understanding. When society began to accept as a commonplace the responsibility for those who have this disease and cannot purchase the proper care, the health officer perforce acquired certain administrative duties which increased as the efforts to control tuberculosis increased. He also acquired familiarity with the problem which divides naturally into two questions—How many tuberculous are there? and What facilities do we need to carry the load?

However, and now we come to the sad part, the health officers did not show a similar understanding of general hospital facilities. The fact that society's acceptance of responsibility for those having general illnesses does

* From the Division of Domestic Quarantine. Read before the Health Officers Section of the American Public Health Association at the Sixty-ninth Annual Meeting in Detroit, Mich., October 11, 1940.

not begin to compare with its acceptance of responsibility for the tuberculous certainly has a great deal to do with this difference in understanding and may be considered an extenuating circumstance. At any rate, they were much less precise in their answers. Some skipped the questions as to general hospital accommodations. Some gave perfunctory answers which indicated quite clearly a lack of interest in the subject. The majority of those questionnaires which came back to us with the greatest promptness carried answers which might be described as dubious clichés, to wit: "Everyone resides within 30 miles of a hospital." "There are plenty of unoccupied beds in existing hospitals." "We cannot support the hospitals we have." "Everyone needing hospital care is receiving it."

These rather loosely dogmatic statements were applied to states showing 1.3 beds per 1,000 population and to those showing 5.3 beds per 1,000; to states with 50 per cent and those with 80 per cent of bed use; and to states varying in patient days of care per 1,000 population from 209 to 1,361 days. Only rarely were deficiencies in outpatient facilities mentioned or inadequacies in any of those services which hospitals furnish in addition to bed care. I hope you will pardon a certain skepticism shown in reviewing these replies, but the question frequently arose as to whose broadside a health officer had been reading.

Now if health officers did not belong in any scheme of events in which general hospitals play a part, this lack of conviction and of information would not matter at all. But they do belong in such a scheme of events. The changing nature of public health has shifted the general hospital into public health prominence. That is just one of those facts of life which we could not dodge if we wanted to. Even circumscribed programs of public health may demand the use of the hygienic laboratory, the x-ray, the electrocardiograph, basal metabolism apparatus, and similar aids to diagnosis and therapy. Health departments of today require clinic facilities, and many of the patients who come to those clinics will prove to be in need of bed care. Hospitalization is absolutely necessary in numbers of maternity cases. Some of the venereal disease cases can be treated to better advantage in hospitals than on an ambulatory basis. Tuberculosis sections to general hospitals are now being recommended by many authorities. The old isolation hospital is losing vogue, for with modern technic and facilities communicable diseases may readily be handled in a unit of a general hospital.

This relationship, which has developed into interdependence, between hospitals and public health agencies has been ably covered in reports of committees [1] of the American Public Health Association and the American Hospital Association. Unless such reports are to be abortive, which heaven forbid with all the work to be done in getting people to hospitals who need hospital care, they should be made the preliminaries to action.

In considering what I should say before you today, I have taken into account my own feeling as to the importance of this whole subject and my dismay at the lack of interest and understanding on the part of health officers as an excuse for presenting the ABC's of the general hospital situation in the United States. Some of you may feel that what I have to offer appears to be a rehashing of much that has been said and written before, and you will be quite right—it is a rehashing, but I hope you will bear with me because I think it is important.

EXTENT OF HOSPITAL FACILITIES

I would like to devote one paragraph

to a few summary figures on facilities and services afforded by hospitals of the three medical types. The general and allied special hospitals * registered by the American Medical Association [2] number 4,900 and include 490,000 beds. Some 9,400,000 patients are admitted annually to these beds and are given over 122,000,000 days of care. Mental institutions are less numerous, numbering in all only 600, but they are large for the most part, they operate at maximum capacity, and their turnover of patients is low. A total of 210,000,000 days of care is given in mental hospitals each year, but the number of new admissions is only 190,000. The tuberculosis hospitals number 480 and have a combined capacity of 76,000 beds. They admit 91,000 patients annually and furnish 24,000,000 days of care.

In analyzing the distribution of hospital facilities, I shall offer only figures on the general and allied special hospitals. Not because the mental and tuberculosis hospitals present no problem, but rather because the general and special hospitals are the institutions to care for some of the most unregarded needs among our population—the need for hospital assistance in meeting old chronic ailments and new acute ones, the need for care in communicable disease, in childbirth, or in orthopedic impairments.

More than 400,000 beds are distributed among some 4,500 registered hospitals which represent the aggregate general and special facilities owned by non-federal agencies. Hospitals operated by the federal government are excluded since they serve only certain classes of beneficiaries and are not available for general use to the people of the areas in which they are located. Of these 400,000 and more beds, one-quarter are under the control of state, county, city, or a combination of county-city governments; almost two-thirds are controlled by churches, fraternal orders, and other nonprofit associations; and one-tenth are maintained by individuals or organized groups referred to usually as proprietary agencies. Like physicians, hospitals derive a large proportion of their income from fees paid by patients. You know exactly what that means—if an institution depends for most of its income upon fees and wishes to remain solvent, it is not going to be able to offer many services to those who cannot pay the fees. To cover the deficit caused by that which they do give in free and part-pay services, they must boost the fees of those who pay.

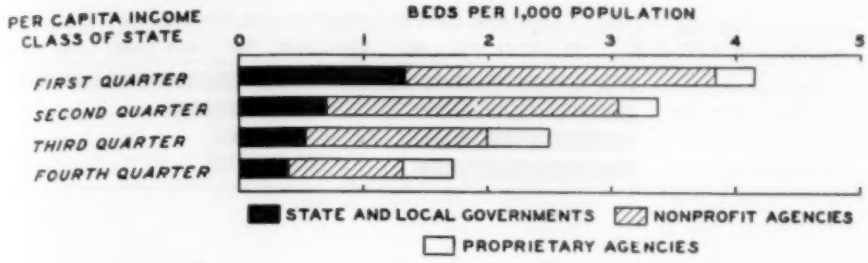
These facts sound so simple when uttered that one is almost abashed to present them in formal discourse, but they are precisely the facts which account for insufficient hospital care, and they are apparently ignored by those who claim that our hospital facilities are plenty good enough.

The charts presented here to illustrate a few of my points show the states divided into 4 groups according to their economic position as determined by per capita income. I should explain perhaps that my basic material comes from data collected by the Public Health Service in connection with its census of hospitals.[3] The per capita incomes are taken from a report put out by the Bureau of Foreign and Domestic Commerce.[4]

The upper quarter of states in Figure 1 includes many industrial states, especially of the Northeast, and also the District of Columbia where the per capita income at $1,165 is the highest in the nation. In other words, this top group represents a population which

* The hospitals included under the term "general and allied special" are those that furnish general care together with such specialized services as are given in maternity cases, orthopedic cases, conditions involving eye, ear, nose and throat, or contagious diseases.

FIGURE 1—Beds per 1,000 Population in General and Special Hospitals of Different Control, by Per Capita Income Class of State



has a high degree of security, carries insurance on life and limb, and is able to select its medical care.

In this quarter of the states, there are 4.16 beds per 1,000 people. The number drops in the next two quarters where the per capita income is lower and the people consequently are possessed of less security on the whole. In the lowest quarter, which includes the poorer agricultural states, the beds per 1,000 population drop to 1.72. On a population basis, hospital beds under proprietary control are more common in states with low incomes than in the relatively prosperous states. The ironical fact in this distribution, of course, is that proprietary hospitals can offer the least to the poorer populations because they depend the most upon fees from patients. Hospitals in this group derive more than 90 per cent of their income through fees paid by persons admitted for care. You can also estimate with your eye from this graph what our data on analysis show to be true—that hospital facilities managed by state and local governments and by nonprofit associations are 3 times more numerous in the quarter of states reporting highest per capita income than they are in the states in the lowest economic position.

The ratios of beds to population show even wider ranges between individual states than one might suspect from this chart which depicts only group performance. The District of Columbia and the State of Massachusetts, both with high per capita incomes, have more than 5 beds per 1,000 persons, while Arkansas and Mississippi, in the low income brackets, have little more than 1 bed per 1,000.

These contrasts would not be at all unseemly if it could be argued and proved that in the financially favored upper quarter of states there is more illness, and as you go down through descending per capita incomes you find that people are heartier and less susceptible to the various ills of the flesh. Many thorough inquiries have been made in recent years into the amount of illness occurring among the people, and they show that precisely the opposite is true.

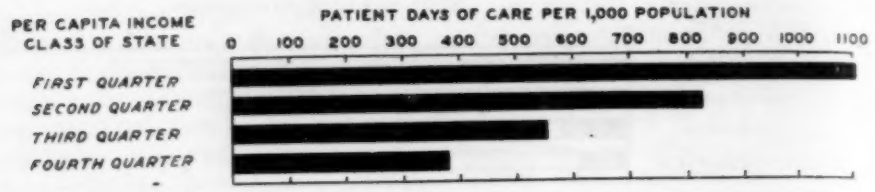
A recent study based upon data from the National Health Survey has this statement on the frequency of serious illness at different income levels [5]:

> The excess in the relief group over the rate in the group with incomes of $5,000 or more is 59 per cent for all causes, 49 per cent for acute diseases, and 85 per cent for chronic diseases.

The following expression of the amount of disability at different income levels is taken from the same report:

> The excess in the low income groups is greater in terms of days of disability per person per year than in terms of frequency, because of a longer average duration of cases in the low income groups. The relief group

FIGURE 2—Patient Days of Care per 1,000 Population in General and Special Hospitals, by Per Capita Income Class of State


PER CAPITA INCOME CLASS OF STATE
PATIENT DAYS OF CARE PER 1,000 POPULATION
0 100 200 300 400 500 600 700 800 900 1000 1100
FIRST QUARTER
SECOND QUARTER
THIRD QUARTER
FOURTH QUARTER

shows an excess of 132 per cent over the $5,000 class, and the non-relief group under $1,000 an excess of 68 per cent.

AMOUNT OF HOSPITALIZATION

Now if the per capita income of an area betokens the quantity of hospital facilities existing there, as shown by Figure 1, will it also betoken the amount of hospitalization which goes to the inhabitants? Theoretically, one would guess that it should. Figure 2 says that in fact it does.

Figure 2 is based on aggregate days of care arrived at by multiplying the average daily census reported by the general and special hospitals by 365. Since a few hospitals containing approximately 2 per cent of all beds failed to report the number of patients per day, the total used represents a slight understatement.

Figure 2 tells the story very well of the amount of hospitalization according to per capita income. States of the highest income group show more than 1,100 days of care per 1,000 population; states of the lowest income group show 377 days. The District of Columbia, Massachusetts, and Rhode Island, 3 of the wealthiest members in this union of states, actually exceed 1,300 days of care for every 1,000 persons, while 2 of our poorest members, Arkansas and Mississippi, show a little over 200 days for the same number.

PERCENTAGE OF OCCUPANCY

Our consideration in Figure 3 is the extent to which the available hospital beds are utilized. The idea of percentage of occupancy used in this figure means the ratio of the average daily census to the number of beds reported by the hospital.

According to Figure 1, there are 1.72 beds per 1,000 population in the lowest quarter of states, and 4.16 per 1,000 in the highest. Other factors being equal, one would expect the people who have only 1.72 beds per 1,000 to produce a higher percentage of occupancy than do those people having 4.16 beds per 1,000. But it just does not work out

FIGURE 3—Percentage of Beds Occupied in General and Special Hospitals, by Per Capita Income Class of State

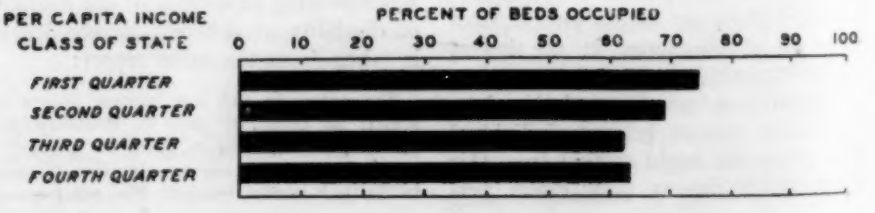
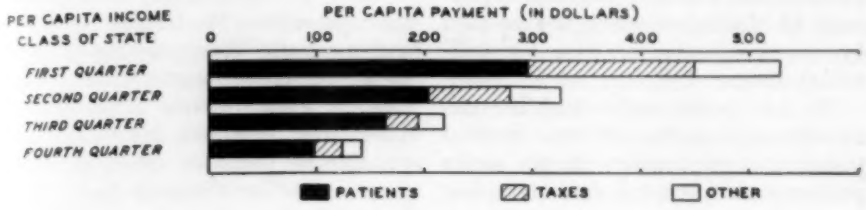

PER CAPITA INCOME CLASS OF STATE
PERCENT OF BEDS OCCUPIED
0 10 20 30 40 50 60 70 80 90 100
FIRST QUARTER
SECOND QUARTER
THIRD QUARTER
FOURTH QUARTER

FIGURE 4—Estimated Annual Per Capita Payment for Care in General and Special Hospitals, by Per Capita Income Class of State



this way. In the top group three-quarters of all general hospital bed facilities are occupied. The proportion drops nearly to two-thirds in the next quarter, and goes lower still in the third and fourth quarters. The 2 states lowest in per capita income are the only 2 reporting on the average less than half their beds occupied.

Let me add parenthetically that for larger hospitals 85 to 90 per cent occupancy is considered optimum in usage when computed on an annual basis, since provision must be made for renovation, for emergencies, and for seasonal variation in demands. Small hospitals experience great difficulty in accommodating more than 75 per cent annual occupancy if the service is varied in character.

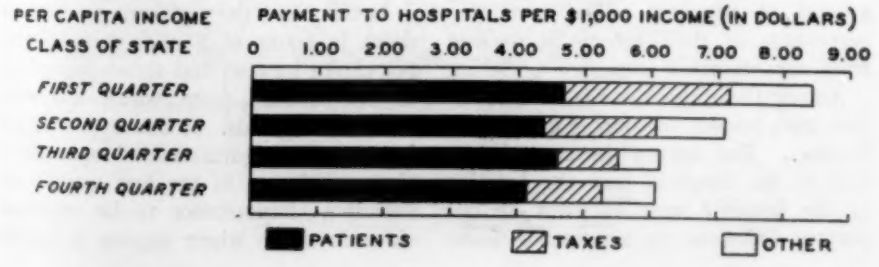
Figures 1, 2, and 3 have this to say, then—that the proportion of hospital beds to population decreases as the per capita income goes down; but, that the people in poorer regions occupy their fewer beds less than the people of prosperous regions occupy their larger number of beds.

SOURCE OF HOSPITAL FUNDS

Figures 4 and 5 present the influence of income upon hospitals and hospitalization through an analysis of the sources of funds obtained by general and special hospitals.

Per capita payments to hospitals are the sums obtained when all hospital income, exclusive of gifts for permanent endowments, is divided by the total population of the area. The estimated per capita payment for the continental United States, I might mention, is $3.37. Figure 4 shows the contrasts between the four groups of states used in this discussion. Per capita payment starts at more than $5 in the upper economic group and drops to $3, to $2, and finally to $1.50 in the lowest economic group. Even more significant than these descending payments are

FIGURE 5—Estimated Annual Payment per $1,000 Income Within State for Care in General and Special Hospitals, by Per Capita Income Class of State



such contrasts as those between the $7.05 per capita payment in Massachusetts and the $.67 per capita payment in Mississippi which are revealed by an examination of data for individual states.

We can better understand the circumstances which govern hospital policy when we consider the per capita payments for hospital care according to the three main sources from which they are derived:

1. Fees for regular and special services collected directly from patients,
2. All tax funds, emergency or otherwise, appropriated by governments,
3. Donations, interest, and miscellaneous income that may be used to meet operating expenses.

According to Figure 4, these sources vary between the four groups of states to about the same degree that the total per capita payments vary. Behind these averages, however, there are certain interesting extremes. Fees from patients from the District of Columbia, wealthiest of areas in point of income, amount to $4.22 per capita, and in the second poorest of the states, Arkansas, they average $.46. The second source of hospital funds—tax contributions—shows a variation from $2.15 in California to $.01 in Alabama. The third group, which includes interest, bequests, and funds from miscellaneous sources, changes from $2.07 per person in Rhode Island to $.01 in Mississippi.

For all hospitals throughout the United States, per capita payments are made up of fees collected from patients to about 62 per cent and of taxes to around 24 per cent. The remaining percentage of their income is derived from various other sources.

Among the states there is wide variation with respect to sources of hospital income. The agency in control, the size of the hospital, and the location of the hospital seem to exert an important influence on supporting financial structure. Proprietary hospitals with few exceptions obtain 90 per cent or more of their income through fees from patients. The smaller hospitals, and especially those existing alone in their respective communities, draw most of their revenue from patients. The large endowed institutions are peculiar to populous cities, especially those in the northeastern part of the United States.

Certain unfortunate implications reside in this high percentage of income from patients. It is the people who are ill and often at the same time handicapped in earning capacity or deprived of it altogether who must carry the main part of the hospital load. Or, if they are unable to carry it, the wage earning members of their family are forced to take it up. Furthermore, the hospital which depends mainly upon fees for income can give only limited services to the very poor and to that marginal class who can get together their necessities but simply cannot manage extraordinary expenses.

It would help if the proportion of funds secured from taxation were larger in those states with less per capita income, but Figure 4 shows that quite the contrary is true.

PAYMENT TO HOSPITALS PER $1,000 INCOME

Figure 5 brings the story down to the individual income, a hypothetical income of $1,000, to be sure, and a hypothetical individual, but nevertheless a basis on which we may personalize these averages to some degree.

In this chart the payments are broken down in terms of $1,000 units of the per capita income, and shown according to the sources from which hospitals secure their funds. It now appears that bequests and governmental appropriations are larger in the first quarter of states, a circumstance to be expected since in states where income is lowest

there will be comparatively few people sufficiently wealthy to be able to make bequests to hospitals.

From Figure 5 it will be seen that when payments to hospitals are related to this $1,000 hypothetical income according to the sources from which they come, the amounts from patients are not noticeably different between the four groups of states. The real story lies in factors not shown in the chart. People in the poorer states have less to spare and are therefore making more difficult payments for the upkeep of their hospitals than are the people in the richer states. Likewise, the total number of days of care is lower by a wide margin in the states of the lower per capita incomes.

OUTPATIENT FACILITIES

I should like also to add a brief accounting of outpatient facilities, since our public health cerebration should take in those persons who may need some hospital services but are not necessarily candidates for hospital beds. My data on this subject come from a study[6] of outpatient facilities which was based upon a questioning of some 1,500 hospitals reported by state hospital associations as offering organized service for ambulatory patients. Eighty-seven per cent of those to which schedules were sent returned them. Of these, however, only 767, or 60 per cent, were found to be operating true outpatient departments. Hospitals in which the control was federal or industrial and those under proprietary ownership were not included since their requirements for admission usually are such that they do not serve the same clientele as do outpatient departments of general community hospitals.

Two-thirds of the departments enumerated in this study were found in large cities of 100,000 or more inhabitants, and this fact takes on significance as you look over population tables for the United States and find that only 3 per cent of the cities come within such a range. Sections of the country in which large cities are situated show the greatest number of general outpatient departments. Such departments with their particular services toward the general health are characteristic of hospitals along the middle and northern Atlantic seaboard, the Great Lakes region, and the West Coast.

FIGURE 6—Geographic Distribution of Hospitals of Different Control and Bed Capacity Classifications in the State of Tennessee

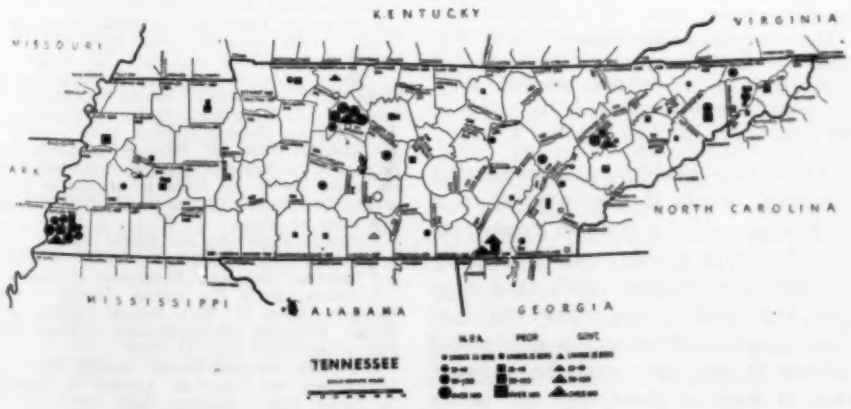


Figure 6 is a spot map showing the hospitals of one state. You will observe that they are shown in their approximate geographic locations by symbols which differ according to control and which also vary to show size. Such a map made on transparent paper may be used over base maps showing population density, economic resources, industrial development, and other characteristics of a state. There is undeniably a dramatic value in showing the hospitals of a state in relation to its other developments by this visual method that cannot be touched by setting out the same facts in a table or a graph, although the latter are of course more precise.

I would like to urge upon all public health workers the importance of analyzing the adequacy of our hospital facilities, an adequacy which must be interpreted according to the need for such facilities and according to the increasing responsibilities of our public health movement. I hope you have gathered from this paper:

That both the presence of hospital facilities and their utilization depend upon the purchasing power of an area.

That the number of beds per unit of population is roughly proportionate to the financial means of the area.

That bed facilities in the general and allied special hospitals are almost 2½ times as numerous in the wealthier states of the first quarter as in the poorer ones of the fourth quarter.

That outpatient departments are to be found for the most part in large centers of population and are most in evidence along the upper Atlantic seaboard, in the region of the Great Lakes, and on the West Coast.

These facts would be only interesting statistical details if they applied to a land where all the poor in compensation for their poverty were blessedly immune from disease. But, as it happens, they apply to the United States of America where illness strikes harder and oftener at the poor and the indigent than it does at those who are better off. These facts therefore take on an appalling significance which rather gives the lie to some of our national pretensions.

You often hear the boast that this country does not have one law for the rich and another for the poor, but that all stand alike before the bar of justice. Some of the more roseate discussions on the state of the nation's health carry the assurance that in this country all men likewise stand equal before the science of medicine. In this latter claim, however, certain bits of sophistry may be detected which do not square with all that the data have to say.

The hospital situation is not so simple that it may be dismissed with a wave of the hand and some pleasant generalities to the effect that everyone lives within 30 miles of a hospital, that no one is actually going without care who needs it, that there are plenty of hospital facilities to accommodate everyone who has an ache or a pain. You cannot dismiss basic social and economic inequalities and their results by such offhand pronouncements—it is ineffectual talk to do so, and this is no subject on which to talk ineffectually. I hope the facts presented to you have appealed to your sense of realism and will assist you in dealing with the hospital situation in plain terms.

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Incubators for Premature Infants*

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THE premature infant's need for special provisions for regulation of body temperature has long been recognized. To meet this need a "hatching cradle" was devised in France nearly a hundred years ago, and in the intervening years other types of warm beds and incubators have been developed. The modern types of incubators do not differ greatly in general principles of construction from the earlier types. Advances have, of course, been made in mechanical operating devices, chiefly in connection with the use of electricity.

The clinician who contemplates the purchase of an incubator wishes to obtain one that will maintain the body temperature of the premature infant at the point that he considers "optimum." Some clinicians will wish also to have a type that will regulate the relative humidity of the air within the incubator, and some wish to be able to increase the oxygen content.

A large number of incubators are available at the present time, which vary widely in type, construction, size, price, and method of operation.

When one is confronted with the problem of selecting an incubator, the only guides available are clinical experience and the claims made, and in some instances published, by the makers. Search of the medical literature has not revealed any clinical studies of the relative advantages of different types of beds.

Numerous requests have been received at the Children's Bureau for information in regard to the types of incubators available and their comparative effectiveness. It became obvious that studies should be made, including:

1. Testing of the mechanical construction and performance of incubators in relation to the claims of the makers and to clinical requirements.
2. Use of the results of these tests in the development of standards for construction and performance of incubators to meet requirements for safety and convenience.
3. Clinical testing of incubators under carefully controlled conditions.

A study of incubators was begun in April, 1940, in coöperation with the National Bureau of Standards. In so far as possible with the material at hand in a relatively brief period of study, this paper is reporting upon the first two of the items named above; the third item, clinical testing of incubators under carefully controlled conditions, has not yet been studied.

* Read before the Maternal and Child Health Section of the American Public Health Association at the Sixty-ninth Annual Meeting in Detroit, Mich., October 9, 1940.

MATERIAL AND METHOD OF STUDY

Tests of 12 electrically heated incubators, loaned for testing by 9 different makers, were carried out in the laboratories of the National Bureau of Standards. Differences in construction in the incubators make it necessary to classify them in 3 main groups as follows:

1. The first group consisted of 4 self-air-conditioned closed incubators; 2 of these were bottomless boxes to be used on a crib or mattress, and the other 2 were completely enclosed units, 1 providing gravity ventilation and the other having a motor and fan for ventilation and devices for air cooling and for administration of oxygen.
2. The second group consisted of 4 hooded metal boxes; 2 of these were semihooded, and 2 were water-jacketed, with the top partly covered and with a canopy over the open head end. Each of the latter 2 had in addition a special cover, to be used when oxygen is administered.
3. The third group consisted of 4 cribs with metal-casing sides and open tops.

The tests for performance were carried out in an air-conditioned laboratory in which the relative humidity was about 30 per cent at temperatures of about 72° F. and 82° F. In addition to tests made under these conditions, one incubator that provided by the use of ice for reduction of temperature and of relative humidity was tested in a room environment of approximately 90° F. and 60 per cent relative humidity.

Time will not permit complete description of the technics of the various tests, but mention will be made of those that may be of interest to an audience not primarily interested in physics and engineering. For example, readings of temperatures were made in 12 different places (parts of the beds and in the room) within a 5 minute period, by means of resistance thermometers accurate to 0.2° F. To determine the relative humidity within the incubators that provided for humidity control, thermocouples with wet and dry junctions were used, making it possible to take frequent observations that were accurate to within 2 per cent in absolute value.

The ventilation within the incubators was examined by 3 methods: (1) measurements of air movements with an anemometer having a range of 5 to 150 ft. per minute; (2) observations of smoke patterns so as to trace air currents; and (3) gas analyses of the incubator atmosphere. These analyses were made at regular intervals after the closed incubator had been flooded with oxygen.

During some of the tests two hollow copper cylinders covered with cloth served as proxies for infants. Internal electric heaters provided controllable energy output. Water containers with wicks produced the amount of moisture calculated for an infant of given surface area. An infant weighing approximately 2 kg. was thus represented in relation to surface area, energy output, and amount of moisture evaporated.

RESULTS OF TESTS

Each maker will be sent complete details of the results of the tests of the incubators made by him. A brief summary of the results of the tests follows:

The tests were made with the general axioms in mind that a bed for a premature infant should be so constructed: (1) that the infant can be readily observed at all times; (2) that there is space above the mattress adequate to accommodate an infant weighing at least 6 lbs., exclusive of space for equipment (such as mattress or pad, thermometer, thermostat, and humidistat and in some instances heating lamps); (3) that the incubator design include mechanically reliable provisions for rolling, tilting, or standing, as may be needed; and (4) that for the infant's safety the incubator provide for ease in maintenance of sanitary standards, prevention of excessively high temperature, undue change in environment during

servicing, useful pilot lights, and adequate ventilation.

Visibility of the infant is a serious problem only in incubators of the bottomless box type, in those that are more than semihooded, and in those that are completely enclosed. Each of the 2 bottomless boxes that were tested had a top almost entirely of transparent material, which gave satisfactory visibility when set at a reasonable height. In the more than semihooded incubators, opaque tops and canopies seriously interfered with observation of the infant. On 1 incubator the oxygen top was provided with too small a window, but on the other the window was completely satisfactory. The design of each of the 2 completely enclosed incubators resulted in the tops being at or above the eye level of a seated attendant. One of these incubators was provided with a window in the side and an opening in the top, both of which, however, were too small for an entirely satisfactory view of the infant; the other was provided with an ample window in the top but none in the sides.

The space provided for the infant varied considerably in the different incubators. One of the incubators, a bottomless box, was both too short (18¼ in.) and too narrow (9½ in.) to accommodate a 6 lb. infant. Another had a clearance of only 7 in. to its oxygen top. Each of the other 10 incubators would accommodate a mature new-born infant.

The 8 incubators that had bases or legs were found to be well braced where needed and to stand firmly. Two of these were without casters, and therefore difficult to move; 6 had smooth-rolling casters. Four were designed to be tilted, and in 3 of these the tilting mechanism was satisfactory. The 2 bottomless boxes were light in weight and so could be easily moved; the 2 semihooded incubators without bases were provided with small handles at both ends but were a heavy and awkward load for one person.

The ease with which incubators can be cleaned depends on the finish and on the nature of the design. Two of the 12 incubators were made of enameled wood; 10 were made of sheet or cast metal and were metal plated or enameled. The metal mattress holders were designed for removal and thus cleaning is made easy.

All 12 incubators were electrically heated, by strip heaters, coils, or bulbs; only 1 of them had provision for non-electric heating. All but 1 were provided with thermostats. For 6 of the incubators provided with thermostats the mechanism for setting the thermostat was easily adjustable by dial or by lever and scale; for 3, it was not readily adjusted; for 1, it could be adjusted slightly; for 1, it could not be adjusted but the heater was provided with switches; the 12th incubator was operated by a rheostat. Only 3 of the incubators had master thermostats to limit the maximum temperature.

Fourteen thermometers were furnished with 11 of the 12 incubators, few of which were of a satisfactory type; 8 were red-liquid-in-glass, 2 were dial-and-pointer, 4 were mercury-in-glass. The thermometers from 10 incubators were tested at 2 different temperatures. One incubator was provided with a thermometer that was of such poor construction that it could not be tested. Of the 13 thermometers tested all but 1 had an error of less than 1 scale division, equivalent to 2° F. In some of the incubators, measurement of the temperature at the center of the upper surface of the mattress and above the head end showed differences of 18° and 12° F., respectively, from the temperature indicated by the incubator thermometer at the place where that thermometer was located. In the majority of the incubators these temperatures were within 5° F. of each other.

Some type of water reservoir to increase relative humidity was provided for in 5 of the 12 incubators. In all 4 of the completely enclosed types of incubators, these reservoirs were effective in maintaining a relative humidity of at least 50 to 60 per cent when the relative humidity of the room was about 30 per cent at either 72° or 82° F. One incubator only was designed so that ice could be used to lower the temperature and the relative humidity when indicated. All 4 incubators were provided with hygrometers, of which 1 was also a humidistat. Three of the hygrometers were tested for at least 2 scale points, 1 gave indications 15 per cent too high, 1, 25 per cent too low; 1, consisting of wet-and-dry bulb thermometers, gave values correct within 10 per cent; the 4th, the humidistat, allowed a fluctuation of 15 per cent or more.

One or more pilot lights were provided on 8 of the 12 incubators; in 3 others, the heater itself, a glowing-filament bulb, was visible to give evidence of the operation of the incubator; in 1, there was no provision made for a warning light. In 2 incubators a pilot light went off and on with the heater. In the other 9, the pilot showed only that the main-line switch was closed. In no case were the pilots arranged to show both that the main-line switch was closed and that the heater was operating. Two incubators were equipped with one pilot to give warning if the water supply became low and another to give warning if the water in the drip pan became too deep; and 1 of these was equipped also to give pilot light warning of ventilation impairment.

The 2 water-jacketed incubators were provided with oxygen tops, including oxygen-air mixing valves. Only 1 of these mixing valves provided the percentage of oxygen indicated for the several possible valve settings. The bottomless boxes could not safely be flooded with oxygen on account of the presence of sparking switches and unprotected lamp bulbs. One of the completely enclosed incubators provided a rather crude but sufficiently accurate flow-meter as well as completely safe electrical equipment. The other enclosed incubator contained a small port for the insertion of a tube for administering oxygen but also included a dangerous sparking switch.

All 12 incubators showed a satisfactorily small temperature fluctuation (less than 2° F.) in stable room conditions. Six showed a temperature variation of about 2° F. in different places on the surface of the mattress; 5, of 5 to 10° F.; and 1, as much as 20° F.

Air circulation tests were conducted on the 6 enclosed or nearly enclosed incubators. One of the incubators, a bottomless box, was found to have much less satisfactory ventilation than the others. Air speeds of 10 to 25 ft. per minute were found in the 1 incubator equipped with a motor-driven circulating fan; less air speed in the other 5 incubators.

SUMMARY

On the basis of the performance of the 12 incubators we have drawn up tentative specifications. It is expected that changes in these specifications will be made as improvement takes place in design and construction of incubators and as results of clinical tests become available.

It is hoped that these tentative specifications will be useful to the makers of incubators in suggesting defects in their present product and possible lines of improvement and that they will be equally useful to potential purchasers as a basis for selection of the incubators that are best suited to their needs.

These tentative specifications are available in mimeographed form.

TENTATIVE SPECIFICATIONS FOR INCUBATORS FOR PREMATURE INFANTS

Prepared by

National Bureau of Standards, U. S. Department of Commerce
and
Children's Bureau, U. S. Department of Labor

I. *Material*

a. The frame, base, supports, legs, hood, case, and mattress holder of the incubator shall be of metal, wood, wood substitute, organic plastic, or other suitable material that does not warp, shrink, swell, buckle, age, or fatigue unduly under operating conditions.

b. Windows shall be of shatterproof glass or other shatterproof, noninflammable, transparent material.

c. Water containers shall be made of nonrusting material.

d. The finish of the incubator and of any mattress holder shall be of metal, metal plate, or enamel, sufficiently smooth, hard, and durable to permit thorough and repeated cleaning.

II. *Size*

a. The dimensions shall be sufficient to house the necessary equipment, with a clear space directly above the mattress of at least 23 in. in length, 13 in. in width, and 9 in. in height.

b. Any mattress holder, or space for a mattress, shall be at least large enough to accommodate a mattress 23 in. in length and 13 in. in width.

Note 1. It is suggested that any mattress provided for use in or with an incubator should have an upper surface which is substantially a plane. No point on the upper surface shall be more than ½ inch below a straight edge laid on the upper surface of the mattress in any direction.

III. *Mechanical Design*

a. The incubator shall be constructed with such openings or windows in the top and sides as may be needed to afford at all times a clear view of the full length of the infant's face and the upper part of his chest by an attendant, whether sitting or standing, near the incubator.

b. The type of incubator that is completely enclosed or more than semienclosed shall be provided with suitable doors, sliding windows, ports, or other openings, to permit convenient servicing of the infant without undue change in environmental conditions.

c. The type of incubator that is a closed box or semihooded box designed to be set on a table, bench, or auxiliary base shall be provided, at opposite ends or sides, with a suitable type of handle in sufficient number to accommodate comfortably two hands at each end or at each side. These handles shall be of sufficient strength and so attached to the incubator as to sustain safely the weight of the entire incubator, necessary equipment, mattress, bedding, and an infant 6 lbs. in weight.

Note 2. It is suggested that the type of completely enclosed incubator or more than semienclosed incubator that stands on the floor and is designed to be rolled, shifted, or moved should be equipped with at least one handle at either end to facilitate handling.

d. The type of incubator that stands on the floor shall be equipped with a base, a stand, or well braced legs, so spaced as to occupy an area of floor not less than 13 in. in width and 23 in. in length.

e. The type of incubator that stands on the floor and is designed to be rolled, shifted, or moved shall be equipped with a sufficient number of freely rolling casters or wheels, with tires of rubber, rubber substitute, or suitable composition, the diameter of each caster or wheel, including the tire, to be at least 2 in.

Note 3. It is suggested that freely rolling wheels may require a brake as a safety precaution.

f. The type of incubator that is designed to permit tilting of the upper part of the incubator without movement of the base, stand, or legs shall have a pivot axis across the center, with a clamp and guide at one end. The clamping handle shall be placed sufficiently high to permit the attendant to reach it without stooping.

g. Water jackets, water tanks, and reservoirs shall be so constructed as to be readily cleaned, filled, and drained completely. They shall be equipped with a pilot light, warning light, protected water gauge, or other device, of such design as to facilitate the maintenance of an adequate supply of water. Water jackets shall be provided with suitable air vents to permit ease in filling and draining.

h. The type of incubator that contains a water-jacketed compartment for the infant shall be provided with some means of preventing accidental flooding of the compartment.

i. The types of incubators that are completely enclosed or are more than

semihooded shall provide a system of ventilation that includes air inlets and outlets, motor driven fans, or other necessary equipment or design that will enable the incubator to fulfil the following requirements, when the air temperature in the infant compartment does not differ from room temperature by more than 10° F.: The incubator shall be flooded with oxygen to not less than 50 per cent *excess* oxygen (above normal) and then allowed to diffuse out by means of the normal operation of the ventilating system. Samples of the atmosphere in the infant compartment shall be tested at sufficiently frequent intervals to give a smooth curve for the return to usual atmospheric conditions. From this curve it shall be shown that the decrease from 40 per cent excess oxygen to 20 per cent excess oxygen takes place in not more than 10 minutes; or the result of an equivalent test, involving some other appropriate gas or material, shall show a decrease from 40 per cent excess to 20 per cent excess above usual atmospheric conditions within 10 minutes.

IV. *Electrical Equipment*

a. All metal incubators shall be provided with means for completing a ground connection to the case.

b. A rubber covered or similarly well insulated waterproof cable or cord, at least 6 ft. long, having characteristics appropriate to the heater load, and with a standard prong-type plug, shall be attached to the incubator.

c. All wires leading from the main-line switch to the heaters and other electrical equipment of the incubator shall be well insulated and fixed in position.

Note 4. It is suggested that the quality of the electrical equipment and wiring conform to the best practice as approved by the Underwriters, to guard against fire hazards.

d. A main-line switch shall be provided on the outside of the incubator at a convenient height. "On" and "off" positions of this switch shall be clearly marked. In addition, a pilot light shall glow in a conspicuous location whenever the cord or cable is attached to a proper electrical power supply and the main-line switch is in the "on" position.

e. There shall be a clear indication of the proper voltage to be used, of whether current is direct or alternating, and of any other information essential to the proper choice of power supply. This information shall be posted on the incubator near the main-line switch.

f. In any incubator designed for use with oxygen there shall be complete elimination of all sparking switches, sparking contacts, glowing coils, unprotected lamp bulbs, or like hazardous equipment. If any of this hazardous equipment is included in an incubator, a proper notice shall be conspicuously posted on the incubator to warn against use of that incubator with oxygen, or near an oxygen tent, or in or near an oxygen-rich or ether-rich atmosphere, or any other inflammable atmosphere.

V. *Temperature and Humidity Regulation*

a. The heater shall be of such a size, power output, and location in the incubator as to provide, with the help of any necessary controls, a top surface mattress temperature of as little as 5° F. above room temperature and also up to at least 15° F. above room temperature. To measure the top mattress surface temperature thermometers shall be placed on the mattress in thermal equilibrium with their surroundings and shall be covered with a 90 to 100 per cent wool blanket about ⅛ in. in thickness or weighing about ¾ oz. per sq. ft. The incubator heating system shall maintain a top surface mattress temperature such that thermometers, placed as described above, shall not differ in temperature from one another by more than 5° F. over a central area of 10 by 20 in. and shall fluctuate not more than 2° F. during operation at a given setting of the controls during room temperature fluctuations of as much as 10° F. in 6 hours. In the completely enclosed types of incubators the same limitations as to fluctuations shall apply also to the air temperature from 2 in. to 6 in. about and above the infant.

b. One or more pilot lights shall be arranged either to show proper operation of the heater, or to give warning of failure of the heater, or both.

c. A reliable and properly calibrated thermometer shall be so placed that its temperature is closely related to the mattress temperature. The enclosed, semihooded, and more than semihooded incubators shall in addition be provided with a reliable and

properly calibrated thermometer so placed as to indicate the temperature of the air surrounding the infant.

d. One or more thermostats as needed shall be so located as to insure compliance with the above limitations as to uniformity and fluctuation of mattress and air temperatures. These thermostats shall be adjustable without necessitating disturbance of the infant.

e. In addition, a master thermostat shall be provided to open a main-line switch when either air or mattress temperature shall rise above a temperature of 101° F.

Note 5. It is suggested that a desirable development might be the location of some type of thermometer and thermostat within the space occupied by the mattress and near the infant to decrease the difference between the conditions immediately surrounding the infant and those surrounding the thermometers and control devices.

f. No thermostat, switch, or fluid device shall be so designed or located that its proper operation would be impaired by a longitudinal tilting of the incubator of as much as 15° from the horizontal, excepting on incubators that tilt the mattress holder only.

g. A hygrometer shall be provided with any incubator that attempts to increase the absolute humidity near the infant above that which obtains in the room, the indications of which shall not differ from the relative humidity near the infant by more than 10 per cent in absolute value.

Note 6. It is suggested that the more elaborate completely enclosed incubators should provide suitable means, such as ice, for controlling the temperature and the absolute humidity separately below room values.

VI. *Oxygen-Therapy Equipment*

Note 7. Some models of incubators are designed to permit the introduction of a continuous or automatically controlled oxygen-rich atmosphere. It is urged that all such arrangements and devices be safeguarded as far as possible against an excess of oxygen above the intended value.

a. Any air-oxygen mixing valve shall be calibrated to show the resulting percentage of oxygen in the mixture in the incubator under operating conditions. Notice of the proper oxygen flow to be used with the calibration of the valve shall be clearly posted on the valve or the incubator. In any incubator that is to be flooded with an oxygen-rich atmosphere one or more suitable warning devices or indicators shall be arranged to show excess oxygen and failure of oxygen flow.

b. Any incubator that is to be flooded with an oxygen-rich atmosphere shall be provided with a suitably located vent, through which test samples may be obtained.

c. Any incubator that is to be flooded with an oxygen-rich atmosphere shall provide a suitable means for maintaining a satisfactory relative humidity.

Renaissance of Industrial Hygiene*

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FOR the purposes of this address, industrial hygiene is defined as the science of health in all of its relationships to employment, and it is deemed to comprise the functions of industrial medicine as well as industrial hygiene and the allied professions of engineering and chemistry, in so far as they are concerned with the health of the industrial worker.

The title refers to the changes now occurring in the field of industrial hygiene as defined. These are characterized broadly by modifications in the employer's motive for furnishing health maintenance programs and the attitude of the general medical profession toward those programs and the physicians and allied professions participating in them.

The important features of these changes are:

1. Recognition of the fact that the workmen must be the primary beneficiaries, and that the maintenance of their health must be the principal objective.

2. Appreciation of the equally important fact that the benefits to industry are sufficiently cogent to justify the active interest of management.

3. Development of a rivalry entirely wholesome in character among the professions concerned.

4. Assumption of a public health viewpoint by those who serve in the health departments of industry, and adoption by them of the methods of preventive medicine.

5. An awakening in the medical profession to opportunities in ethically managed industrial health programs, and an elevation of industrial health to a higher level of respect as a specialty in the science and practice of medicine.

6. Extension of industrial hygiene activities in governmental agencies, especially noticeable at the state level.

7. Recognition of the necessity of employing industrial hygiene procedures in developing an effective national defense.

WORKERS ARE PRIMARY BENEFICIARIES

It is not necessary to remind this audience that medical service in industry was originally employed for the treatment of injuries. The service was emergent in nature. It was regarded by industry very much as a railroad would regard a wrecking crew—something to clear away the wreckage—and as such it was not in high esteem, merely tolerated.

By virtue of the Compensation Acts for occupational injuries, the accident prevention movement, the introduction of the physical examination (which admittedly was first used for the purpose of protecting industry against glaring compensation risks), and more recently the enactment of the occupational disease compensation laws, industrial traumatic surgery has evolved into industrial hygiene, and with this evolution has come recognition of the fact that the best approach to an industrial health

* Chairman's Address delivered before the Industrial Hygiene Section of the American Public Health Association at the Sixty-ninth Annual Meeting in Detroit, Mich., October 8, 1940.

program rests in a sincere desire to benefit the workmen rather than solely for the purpose of protecting the employer.

The object is to assist the workmen in so far as is practical in avoiding the disabilities of ordinary sickness as well as the disabilities of occupation. To be wholly effective, such a program must coincide with their interests, and all who serve them in relation to the program must do so with unquestioned honesty and fairness. In recognizing this fact, management no longer expects or wishes biased opinions from its physicians in disputed compensation claims. Facts, and a fair expression of judgment in the interpretation of them, are what management desires. This permits industry to obtain the services of competent physicians and industrial hygienists who are interested in the scientific and humanitarian aspects of industrial health, and are capable of applying them in the solution of the health problems of industry.

INDUSTRIAL HYGIENE BENEFITS INDUSTRY

Sound managements, ever alert to the necessity of profitable enterprise, do not wish their medical departments to become overly expensive, and in their expansions of health service they proceed with some justified caution. Fortunately, however, as medical departments are coming more and more to operate on an employee-service basis, managements are more willing to allow larger appropriations for capital expenditures and a higher annual employee per capita for operating expense. This can be interpreted only as meaning the assignment of greater importance to medical service in industry by management. It is an acknowledgment of the value of the contributions which a good industrial health service can make to labor-relationships and efficient plant operation.

RIVALRY DEVELOPS IN THE PROFESSIONS CONCERNED

In the meantime, industrial hygiene engineers have proved their worth. Although their efforts have been directly concerned with engineering methods for the protection of workers against occupational diseases, their recommendations have frequently resulted in a more effective and economic production, which is always welcome in industry.

Their status now is that of a relatively new profession which is finding success, and naturally there is some rivalry among the medical profession and industrial hygienists, and among groups of the latter themselves, for the position of leadership. This is to be regarded as a thoroughly wholesome competition, the outcome of which will be further accomplishments in the field of industrial health—and these accomplishments will decide the outcome. There is no cause for concern in such wholesome rivalry.

PUBLIC HEALTH VIEWPOINT SPREADS

An important change, perhaps the most fundamental and consequently the most important, is in the growing influence of public health on the trends of medical departments in industry.

Witness the interest in the engineering methods of industrial hygiene, the health examinations of workers, studies in sickness absenteeism, and the tuberculosis, syphilis, and other disease control programs in industry.

Because this viewpoint is essentially that of disease prevention, about which there is no controversy, it is acceptable to all parties who are directly or indirectly concerned—the workmen who are primarily benefited, employers who profit by the reductions of lost time and improvements in efficiency, the medical profession whose rights are conserved, and the public, whose general level of health is raised. In this

may be found the real basis of the renaissance in industrial hygiene.

AWAKENING OF THE MEDICAL PROFESSION

With this change of viewpoint from traumatic surgery to health maintenance, came the creation of the Council on Industrial Health of the American Medical Association, which was quick to appreciate the greater abundance of opportunities for the ethical practice of medicine in industry and the large segment of industry yet available to the general practitioners of medicine for service of a profitable nature.

The great need of industry is in this large segment, and something like 85 per cent of all industrial workers are involved. The Council offers the following practical program for the guidance of general practitioners in meeting their obligations with respect to this problem:

1. Train physicians to recognize and report occupational disease.
2. Train industry and labor to the value of industrial health conservation.
3. Elevate medical relations and standards under workmen's compensation.
4. Scrutinize all social legislation affecting industrial health.
5. Clarify relationships between industrial and private practitioners.
6. Improve relations between physicians and insurance.
7. Establish working relationships with all state agencies interested in industrial health.

The Council gives promise of being enormously helpful to the workers, the managements, the medical profession itself, by preparing the profession to meet this great need; and there are indications of its ability to do so.

OFFICIAL HEALTH AGENCIES ADOPT INDUSTRIAL HYGIENE METHODS

Thirty-one states now have industrial hygiene bureaus. Some states have branch laboratories in important industrial centers.

This conception was indeed an inspiration. Industry is expected to supply safe places of employment and healthful working conditions. To comply with these expectations industry needs and requires the assistance of those who have specialized knowledge in the maintenance of industrial health —physicians trained in the medical needs of industry, hygienists, engineers, and nurses. The larger manufacturing establishment can employ this trained personnel. The smaller establishments which employ 62 per cent of the workers, must look to outside sources for this aid—the general medical profession, consulting laboratories, and state industrial hygiene bureaus. And these state and local bureaus meet this need.

THE NATIONAL DEFENSE

In times of national emergency when the call to arms becomes imperative, we realize the supreme importance of the military forces, and all essential resources are placed at their disposal.

Nevertheless, we must not overlook the health of the workers who produce the munitions of defense, for in their conditions of health, to a considerable degree, rest their ability to produce.

On September 16, Surgeon General Parran convened a conference of State and Territorial Health Officers for consideration of the health problems which experience assures us will arise out of the mobilization and equipment of the draftees. During the conference, the Division of Industrial Hygiene of the U. S. Public Health Service presented its program for the maintenance of health in the industries essential to national defense.

This program recognizes the soundness of the industrial health maintenance program which has evolved out of the experience of recent years, and seeks only to strengthen it in those respects found necessary to national defense purposes.

The keynote of the report was sounded in the following statement:

"No matter what the job is, we know it can be done safely, provided we utilize the knowledge already developed in the field of industrial health."

The report stressed the importance of securing coöperation from all government, state, and local official agencies, and volunteer organizations, some of which have already made their contributions, others of which are proceeding rapidly with the development of theirs. The program seemingly is planned particularly for the purpose of strengthening industrial hygiene services of the various states.

This discussion further stated:

In planning a state program for industrial hygiene services it is not necessary to go beyond present-day practice. We are not recommending that the states improvise a program with the idea that the entire program will be abandoned at the end of the present emergency. On the contrary, the program which the Service is recommending to the various state industrial hygiene units is the type of program which should be taken to integrate the industrial hygiene activities with the other activities in the state department of health, such as coöperative efforts with the venereal disease division for the control of venereal disease among workers, and similar arrangements with the division of tuberculosis for the control of tuberculosis among workers. Coöperative programs could also be developed with the division of epidemiology, division of sanitary engineering, division of public health nursing, and the division of dental hygiene. In other words, an effort should be made to bring all adult health services directly to the worker at his place of employment.

It goes without saying that coöperation should be obtained from such agencies as the state medical society committees on medical preparedness and the committee on industrial hygiene, the local university's medical and engineering schools, organized industry, organized labor, members of the industrial physicians and surgeons, the state labor department, industrial commission, the regional director of the U. S. Department of Labor's Committee on the Conservation of Manpower in Industry, the state safety council, nursing societies, the state dental society, and, especially, the various divisions within the health department itself. The nursing bureau of the state health department could be very helpful in such activities and in rendering consultation services to the plant nurses. It is extremely important that the private practitioners be reached through the state medical societies, in view of the fact that recent studies made by us indicate that *85 per cent of the workers in American industry do not have full-time medical supervision in the plants.*

The program is very practical. The main task is to evaluate quickly the important hazards to health in a plant and immediately give specific and practical recommendations to management for the elimination of the hazards encountered. Briefly, the program may be divided into five categories:

1. The investigation and control of specific industrial hazards. Some of the industrial hazards to be investigated and controlled are: Exposure to dusts, fumes, gases, vapors, mists, defective illumination, ventilation, noise, excessive temperatures and humidities, abnormal pressures and posture.

2. Advice to industry and others on the location of new plants and on the renovation of old plants, in the interest of safety and health.

3. The promotion of physical examinations and medical services by industry.

4. The preparation and dissemination of information on various toxic materials and processes, including approved designs of exhaust systems for the control and elimination of atmospheric contaminants.

5. The promotion of measures for the control of syphilis, tuberculosis, and other communicable diseases among industrial workers.

The discussion closed with emphasis on the following salient points:

1. We must not forfeit the gains that have been made in the past 5 years for the sake of expediency.

2. We have created an industrial hygiene program in the nation not as an emergency improvisation, but as an integral part of our national life in the future.

3. Industry is cognizant of the fact that it pays to control and prevent industrial health hazards.

4. Labor is sufficiently well informed, organized, and articulate to demand safer and more healthful working conditions.

5. We have at hand the tools and the information necessary for creating healthful working conditions and for improving the health of our workers.

6. There is no longer any question as to the importance of industrial hygiene and whether or not such services are to be given to the public.

In order to accomplish the objectives of the program, an elaborate system for the training of medical and other personnel for service in industry is necessary. Present plans contemplate a formulation of training programs and the establishment of training centers in designated institutions of learning, where trainees will receive from 3 to 9 months of training, depending upon their previous preparation. This training will comprise laboratory work and practical field work in industrial hygiene, as well as actual experience in the medical departments of industry.

SUMMARY

To those of us who served in industrial hygiene during the World War, this national defense program is very pleasing. Culminating as it does out of the last 20 or more years of research and experience, it demonstrates vast progress; and doubly pleasing is the ever-widening accomplishments of the public health viewpoint.

We are convinced that we are now on safe ground, that industrial hygiene has demonstrated its humanitarian and utilitarian values, and that more than ever before we can expect full coöperation of all parties concerned.

Air Contaminants Papers Available

THE following papers, presented at the second session of the Industrial Hygiene Section of the American Public Health Association, at the Sixty-Eighth Annual meeting in Pittsburgh, Pa., on October 19, 1939, as part of the "Symposium on Field Methods for Rapid Determination of Air Contaminants," are available as separates free of charge, as long as the supply lasts.

Vapors and Their Routine Measurement. By Philip Drinker.

Rapid Methods for the Determination of Gases in the Air. By F. A. Patty. Discussion by L. B. Berger.

Rapid Methods for the Estimation of Air Dustiness. By Helmuth H. Schrenk, Ph.D. Discussion by C. J. Urban.

They appeared in the September and October, 1940, issues of the *American Journal of Public Health.*

Address requests for copies to the American Public Health Association, 1790 Broadway, New York, N. Y.

Use of Miniature X-Ray Films in Tuberculosis Case Finding*

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As the program for the control of tuberculosis grows in intensity it becomes more and more apparent that the finding of cases is fundamental in preventing the spread of this communicable disease. With the sources of bovine infection cut to a small fraction of their previous importance, the human cases remain the chief sources of infection with the tubercle bacillus.

It is readily appreciated, however, that tuberculosis is insidious in its onset, either starting with no symptoms of note at all or with acute or subacute symptoms suggesting for some time some more or less harmless condition such as a common cold. Since this is true, waiting for the patient to present himself because he considers himself seriously ill means that the disease has usually developed well beyond the early stage, making it difficult to treat, and requiring a much longer period for recovery, if indeed recovery is possible, than would be the case had it been detected early. Add to this the fact that during this period of progression of the disease the patient has been a menace as a spreader of infection to those about him, there is ample reason to stress the importance of finding the cases, and finding them early.

The methods employed for detecting early tuberculosis have been variously worked out in different places. The value of pooling experiences for the good of all prompts this report on the results of case finding programs that have been employed by the Detroit Health Department.

As reported recently by Edwards and his coworkers in New York,[1] the mass surveying of large groups in the community may be productive in finding many cases, and is not extravagant if groups are selected in which previous experience has shown a higher than average prevalence of tuberculosis.

Wishing materially to improve the case finding in Detroit, it was decided to undertake a survey program in which the private physicians participated in doing tuberculin tests and x-ray examinations of reactors on an extensive scale. Three groups were examined, namely, contacts to known cases; suspects with symptoms; and finally those residing in areas of high tuberculosis mortality. The details of this program have been reported elsewhere,[2, 3] so it is only necessary now to bring the experience with the method up to date.

* Read before the Epidemiology Section of the American Public Health Association at the Sixty-ninth Annual Meeting in Detroit, Mich., October 9, 1940.

Beginning in January, 1937, a very intensive effort was made. With house-to-house visiting by nurses in high mortality areas it was possible to persuade many persons to go to the private physicians' offices for a tuberculin test. This intensive drive was maintained until May, 1938. May, 1938, to June 30, 1940, the program carried on without nursing visits, since funds were not available to continue such an extensive effort.

During the 3½ years' operation of this plan, 136,812 persons were tuberculin tested and 38,395 reactors, or 29 per cent, were found. Thirty-four thousand and fifty-nine of the reactors were examined by x-ray and 890 new cases requiring treatment were detected.

TABLE 1

Medical Participation in Tuberculosis Case Finding

Tuberculin Tests and X-ray Examinations According to the Period During Which They Were Done

December 3, 1936 – June 30, 1940

	Tuberculin Tests Reported			*X-ray Examinations Reported*	
Six Month Period	*Total*	*Positive*	*Per cent Positive*	*Total*	*Verified Cases Found*
First	41,434	10,010	24.2	7,403	213
Second	33,295	9,565	28.7	8,757	204
Third	40,102	12,228	30.5	10,924	216
Fourth	9,303	2,584	27.8	2,644	97
Fifth	5,264	1,652	31.4	1,848	72
Sixth	4,282	1,340	31.3	1,443	55
Seventh	3,132	1,016	32.4	1,040	33
Total	136,812	38,395	29.0	34,059	890
Cases per 1,000 tuberculin tests					6.50
Cases per 1,000 positive tuberculin tests					23.15
Cases per 1,000 x-ray examinations					26.13

There were approximately 800 physicians who took part in this program.

Because of the visits for testing, revisit for reading, and a visit to another physician often for the x-ray, a good many examinations were not completed. Just how many failed to go for a reading of the test is not known since tests without readings were not reported. There were undoubtedly a good number, however. It is known that only 34,059 of the 38,395 reactors were x-rayed, and this is a loss of 11.3 per cent.

This effort, however, was productive of many minimal cases and was successful in raising the per cent of minimal cases reported in Detroit from 13 per cent for the period just before the start of the program, to 26 per cent for the year 1938 during the height of the campaign.

Since the x-ray examination of the chest is the best means of detecting early pulmonary tuberculosis, it has long been thought desirable to have an inexpensive yet accurate method for making such examination so that it might be used directly as a single procedure, thus avoiding losses due to inaccuracies of a single dose tuberculin test, failure to have the test read, or failure to go for an x-ray examination when the test was found positive.

The fluoroscope, the paper film, and more recently photography of the fluorescent screen image on small film have been employed to meet the requirement of economy.

Dr. Hollis Potter [4] collaborating with the General Electric X-ray Corporation undertook to develop a technic that would produce a film large enough to be interpreted readily without enlargement and yet small enough to provide a real saving in film cost. After extensive experimentation it was found that a photograph of the fluorescent image of 4 x 5 inch size best answered this requirement. For over a year it has been possible to use this equpiment in the Tuberculosis Clinic of the Detroit Health Department in order to determine its usefulness as a case finding tool. During this time various studies have been made to test its practicability.

To produce these 4 x 5 inch films or fluorographs, a special fluorazure screen is employed which is mounted in an

enclosed box, a lead glass plate screens out the x-rays allowing only light rays to pass through the large high speed lens mounted at the tapered end of the box which focuses the light rays onto the small film. This system is adjusted to a fixed focus and no shutter is required since the flash of x-rays is timed to give the proper exposures. The source of x-ray is a 500 milliampere rotating anode tube operated up to 80 kv. The exposures are made for 1/20 to 1/5 second, depending on the thickness of the chest. Satisfactory pictures may be taken by using lower milliamperage equipment with a longer exposure, but the films are not as brilliant as when 400 milliamperes are used.

The first experiment with this equipment which was reported elsewhere [5] was for the purpose of checking its accuracy when compared with the full size film taken with an excellent technic. Accordingly, 1,610 persons were examined with both large and small films and the interpretation of each size made independently. Comparison of these readings indicated an inaccuracy of 2.6 per cent only for the small film in comparison with the large. This small error is not considered of great significance, and the authors are sure it would be much less now with greater familiarity with the small film. In fact, Bridge,[6] making a similar study, found less than 1 per cent error.

These small films can be made very rapidly, at least one per minute. If questionable lesions are found, the patient may be called back for a large film. However, for case finding purposes the diagnosis can be sufficiently well made in most instances on the small film alone to decide whether hospitalization is necessary. In a series of 6,104 consecutive small films, in only 51 instances was it found necessary to recall the patient for a large film, 39 of these to help clear up the diagnosis, and 12 because of poor films.

Because of this very satisfactory record, the miniature film has been adopted for the outpatient service for diagnosis in new admissions to the clinic and for checking of patients discharged from hospitals for follow-up examinations. More than 18,000 such examinations have been made and have been highly satisfactory.

Survey projects for special groups have been undertaken. Since this type of x-ray examination is relatively inexpensive it was felt it could be used directly without previous tuberculin testing which had heretofore been widely used, since the test could readily screen out a large number who would not need the more expensive x-ray examination.

In order to place some value upon this comparison in adults, a survey of the women coming to the prenatal clinics of the Department of Health was undertaken. All were tuberculin tested with a single dose of 1/1,000 O.T. and all were x-rayed. Fourteen hundred and twenty-five women were tested, but 144, or 10 per cent, failed to return for the reading of the test. However, these had been x-rayed, and among these 144 women who might have been missed if tuberculin screening had been used to select for the x-ray examination, there were 2 active pulmonary cases—one moderately advanced and one far advanced. Of the 1,281 women who returned for a reading of the test, 610, or 47.6 per cent, were positive. Among the positives were 3 active cases. Among the 671 negatives there were 2 active cases found by x-ray.

While these numbers are small, still they indicate the possibilities for missed cases in tuberculin surveys through failure to return for the reading of the test and failure to respond to a single dose of tuberculin, all of which is obviated by one visit for an x-ray examination of everyone in the group to be surveyed.

This prenatal group survey has been

continued without further tuberculin testing and altogether 3,122 have been x-rayed and 17 cases found, or 0.5 per cent.

Having had such satisfactory results with the small film, it was decided to undertake a more extensive survey of an area of the city where the mortality from tuberculosis was known to be high. This was extremely timely since the medical participation program for case finding was being discontinued.

A second fluorographic unit was secured and placed in a special clinic in the Brewster Housing Project, which is in the center of an area of some 200,000 population, with a mortality of 127 per 100,000 per year. House-to-house visits by volunteer groups, health guilds, lodge and insurance groups organized for this work by the Health Education Division of the Department of Health are being made to encourage everyone residing in this area to avail himself of this opportunity to be examined.

This clinic can handle up to 300 persons per day when the work gets well under way. During the first 12 weeks 4,815 were examined, and 76 active cases (1.5 per cent) found.

TABLE 2

Clinic in Brewster Housing Project

	Cases Found
Primary active	13
Minimal active	22
Moderately advanced active	15
Far advanced active	17
Pleurisy with effusion	7
Miliary	2
Total	76

In addition, a large number of non-tuberculous conditions were discovered, 204 cardiac lesions and 23 non-tubercular pulmonary lesions, which while not important communicable disease problems for the community still are of great importance to the individual concerned, and their early discovery may in some instances make possible the prevention of more serious involvement.

In comparison with other x-ray methods of examination, the 4 x 5 inch fluorograph appears in a favorable light since:

1. The full size 14 x 17 inch celluloid film is the most accurate, but is far too expensive for widespread use, the 14 x 17 inch film being 10 times as costly as the 4 x 5 inch.
2. Sensitized paper is almost as accurate as full size celluloid film, but it still is quite expensive, being about one-half that of celluloid and in addition is bulky to handle and store.
3. The fluoroscope while quite inexpensive is not nearly so accurate (13 per cent error according to Fellows[7]), and has the disadvantage of not giving a permanent record.
4. The 35 millimeter film taken with a small camera as a photograph of the fluorescent screen image is very inexpensive but sacrifices too much in accuracy. This size must be enlarged again before it can be interpreted.

The authors therefore feel justified in concluding that the 4 x 5 inch fluorograph is:

1. Accurate in comparison with large standard films.
2. Can be used without previous tuberculin screening.
3. Is economical and can be rapidly applied to large numbers for survey purposes.
4. Compares most favorably with other methods of x-ray examination which have been applied to large numbers.

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Method of Measuring the Effectiveness of Preventive Treatment in Reducing Morbidity*

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IN 1935, the senior author of this paper, at that time associated with the Delaware State Health Department, undertook an evaluation of the immunization program against diphtheria which the department had instituted in 1926 and had pursued actively since that date. In the course of this investigation certain difficulties were encountered which are common to all such problems. The solution given to them may be of general interest since the evaluating of its activities is one of the perennial problems of a health department.

The appraisal of the Delaware program was undertaken along the most natural and direct line—that of determining how many of the recorded diphtheria cases were among those who had received the immunizing treatment and how many were not. This necessitated checking the name file of cases against that of persons given the preventive treatment. Since age is such an important factor in the incidence of diphtheria, this fact was recorded also. During the eight years, 1927 through 1934, there were 799 cases of diphtheria between ages 1 and 20. Of these, 90 were located in the file of persons who had been given the preventive treatment. This fact alone tells us that the treatment was not 100 per cent successful in preventing cases — a well known fact—but beyond that it does not go. In order to determine the *degree* of success in case prevention we need to know the attack rates, and therefore the sizes and ages, of the "immunized" and "nonimmunized" populations.

Between the start of the Delaware program and the end of 1934, 62,043 individuals were given a complete preventive treatment. A tabulation of these persons according to the calendar year and age at the time of treatment is given in Table 1. To get a picture of the age distribution of this group at any given date requires bringing up to date the ages of persons previously treated. Since with each successive calendar year the person is a year older, the age distribution on any date of

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† The late Dr. W. H. Frost was primarily responsible for the development of the method described in this paper, and had arranged with the present authors for writing it up for publication.

those previously treated, is obtained by adding the numbers given in Table 1 along the diagonals indicated. This procedure was used to derive the distribution given in the last column of Table 1, of the ages of the 62,043 persons, as of December 31, 1934. A similar tabulation could be made at any other date during the time period.

This tabulation gives us some knowledge of the "immunized" persons, and we need to have similar facts about the "nonimmunized." An attempt was made to derive this information by the natural procedure of subtracting the December 31, 1934, distribution from the estimated total population of these ages for the same date. This attempt promptly exposed a serious fallacy in the method, in that the difference between total population and those treated was too small. In certain age groups this deficiency was very striking, and it was clear that if the same procedure of accumulation was continued over a few more years of time the estimated "immunized" population of a specific age would exceed the total population for that age.

A little consideration shows that the reason for this paradoxical situation is that only a part of the accumulated number treated prior to December 31, 1934, would still be present in Delaware on that date. Some would have died, and more would have migrated from

TABLE 1

Distribution by Age and Calendar Year of Persons Given a Complete Diphtheria Preventive Treatment by the Delaware State Board

Age in Years	*1926*	*1927*	*1928*	*1929*	*1930*	*1931*	*1932*	*1933*	*1934*	*Total No. Treated 1926–1934 by Age on Dec. 31, 1934*
Under 1	30	36	48	49	152	226	434	721	434	434
1	23	63	70	83	290	348	280	307	538	1,259
2	40	104	111	117	254	356	206	255	443	1,184
3	45	138	183	143	259	359	187	282	375	1,136
4	55	127	190	168	236	392	197	305	410	1,408
5	102	219	300	254	402	456	223	330	569	1,756
6	517	802	1,009	825	858	917	879	610	1,641	2,912
7	551	1,070	922	785	675	760	708	364	1,065	2,772
8	745	1,103	852	777	519	559	377	305	796	3,078
9	750	1,161	840	846	395	399	248	192	599	3,409
10	796	1,268	1,017	818	374	394	212	140	544	3,353
11	652	1,058	701	579	414	308	237	155	362	3,281
12	382	862	419	393	266	143	180	114	314	3,667
13	258	594	394	214	191	127	212	76	164	3,907
14	135	356	173	140	73	192	172	49	112	4,335
15 and over	385	909	496	267	163	299	242	94	144	21,197
Unknown	166	771	513	225	120	485	391	218	66	7,955
Total	5,632	10,641	8,238	6,683	5,651	6,720	5,385	4,517	8,576	62,043

the state. This is a difficulty universally present in any accumulated register of persons recorded for some event in their lives. It is so obvious for certain registered events that we should never think of using the total register of persons up to a certain date as a population of that date. For example, we should never think of using the marriage registrations in a state prior to any date as a count of the married population for that date or, for that matter, the accumulated births as a count of the total population. The reason that the error in using the immunization file in this way is less glaring at the outset is that it has been accumulated for a shorter time and pertains to a population which has a smaller death rate and perhaps a smaller migration rate than the adults. Nevertheless, the error is serious enough to vitiate any comparisons based on such population estimates. Since it has the effect of overestimating the treated and underestimating the untreated population, it exaggerates any reduction of rates associated with the immunization program, and may create an apparent reduction where none has occurred.

It is thus necessary to adopt some other procedure for determining what degree of preventive accomplishment is indicated by the fact that only 90 out of the 799 cases occurring were located in the treatment file. The solution given to this problem was based on the following reasoning: If we could get a representative sample of the population, of each age and for any given date, entirely unassociated with diphtheria, and see how many of them could be located in the file of persons treated prior to that date, we would have a base line for judging the diphtheria figures.

Many ways might be considered for obtaining such a sample, and it is clear that in truly representative samples of the population, obtained by different means, essentially the same proportions (i.e., within sampling variation) of any age class should be located within the diphtheria treatment file.

From the point of view of the health department, a very convenient choice of sample lies in its own records of the reported cases of the common communicable diseases of childhood (exclusive of diphtheria) to which children appear to be universally susceptible. To test the representativity of such a sample in the Delaware study, the cases of measles, scarlet fever, whooping cough, and chicken pox, in successive years, were separately checked against the diphtheria immunization file. Within sampling variation, for any specific age the same proportion of cases of each of these diseases was located in the file. There is thus no reason to suspect these samples of bias, relative to diphtheria immunization (if we reject the improbable hypothesis that they all have just the same bias). We may therefore assume that the proportions of cases of these miscellaneous diseases for any year, found in the immunization file, reflect the *proportions of the population for that year, which have been given the preventive treatment by the state.* To increase the stability of the estimates, the proportions were computed for the 4 diseases combined.

Table 2 gives the age distribution of the cases of these 4 communicable diseases occurring in successive 2 year periods, and the number and percentage of these cases found in the preventive treatment file. These percentages increase over the time period as would be expected with a developing immunization program.

We now have a base line in terms of which we may judge the relation of the diphtheria cases to the preventive treatment. One procedure for obtaining this judgment would be to apply the percentages given in Table 2 to the estimated total populations of these time periods. This would give " immunized "

TABLE 2

Cases of Measles, Scarlet Fever, Whooping Cough, and Chicken Pox, by Age, Delaware, 1927–1934, According to Presence or Absence in Diphtheria Preventive Treatment File

Age	1927–1928			1929–1930			1931–1932			1933–1934		
		In File			In File			In File			In File	
	Total	No.	%	Total	No.	%	Total	No.	%	Total	No.	%
1	71	2	2.8	65	3	4.6	131	18	13.7	153	30	19.6
2	213	9	4.2	192	11	5.7	329	56	17.0	402	96	23.9
3	247	16	6.5	221	17	7.7	424	82	19.3	483	141	29.2
4	243	17	7.0	243	26	10.7	413	88	21.3	428	95	22.2
1–4	774	44	5.7	721	57	7.9	1,297	244	18.8	1,466	362	24.7
5	290	54	18.6	290	46	15.9	548	136	24.8	571	282	49.4
6	351	117	33.3	345	101	29.3	631	253	40.1	728	386	53.0
7	389	122	31.4	392	176	44.9	608	300	49.3	740	416	56.2
8	244	85	34.8	240	127	52.9	450	228	50.7	482	280	58.1
9	173	80	46.2	168	103	61.3	289	167	57.8	297	199	67.0
5–9	1,447	458	31.7	1,435	553	38.5	2,526	1,084	42.9	2,818	1,563	55.5
10–14	474	203	42.8	277	190	68.6	587	459	78.2	516	396	76.7
15–19	86	8	9.3	67	18	26.9	130	49	37.7	142	78	54.9
1–19	2,781	713	25.6	2,500	818	32.7	4,540	1,836	40.4	4,942	2,399	48.5

and "nonimmunized" population estimations which would furnish the denominators for the corresponding case rates. Because of the difficulty of estimating populations by age, particularly in the postcensal period, this method was not used here, although with good population estimates available it would be sound.

Instead of setting up attack rates, the observed diphtheria cases were proportioned "in the treatment file" and "not in the treatment file" according to the proportions for the other diseases

TABLE 3

Cases of Diphtheria by Age, Delaware, 1927–1934, According to Presence or Absence in Diphtheria Preventive Treatment File, Compared with Number Expected from Proportions of Population Estimated to Be in the File

Age	1927–1928			1929–1930			1931–1932			1933–1934			1927–1934		
		No. on File			No. on File			No. on File			No. on File			No. on File	
	Total Cases	Obs.	Exp.	Total Cases	Obs.	Exp.	Total Cases	Obs.	Exp.	Total Cases	Obs.	Exp.	Total Cases	Obs.	Exp.
1	16	..	0.4	6	..	0.3	9	..	1.2	9	3	1.8	40	3	3.7
2	12	..	0.5	14	..	0.8	23	..	3.9	17	1	4.1	66	1	9.3
3	18	..	1.2	30	..	2.3	21	..	4.1	13	..	3.8	82	..	11.4
4	19	..	1.3	17	..	1.8	19	..	4.0	14	2	3.1	69	2	10.2
1–4	65	..	3.4	67	..	5.2	72	..	13.2	53	6	12.8	257	6	34.6
5	23	..	4.3	18	1	2.9	22	2	5.5	16	2	7.9	79	5	20.6
6	21	..	7.0	33	1	9.7	22	..	8.8	8	2	4.2	84	3	29.7
7	11	1	3.5	18	3	8.1	40	4	19.7	10	3	5.6	79	11	36.9
8	9	..	3.1	14	1	7.4	22	3	11.2	9	1	5.2	54	5	26.9
9	7	..	3.2	9	2	5.5	13	1	7.5	8	4	5.4	37	7	21.6
5–9	71	1	21.1	92	8	33.6	119	10	52.7	51	12	28.3	333	31	135.7
10–14	20	6	8.6	39	8	26.8	42	12	32.8	20	8	15.3	121	34	83.5
15–19	23	1	2.1	17	2	4.6	29	10	10.9	19	6	10.4	88	19	28.0
1–19	179	8	35.2	215	18	70.2	262	32	109.6	143	32	66.8	799	90	281.8

(i.e., for the population), and a comparison with the observed figures was then set up. This comparison is presented in Table 3. From this table, it is seen that if the diphtheria cases had been as unassociated with the immunization treatment as were the other diseases, the 799 cases should have been distributed with 282 cases among those given the preventive treatment and 517 among those not treated. Instead, as stated above, only 90 were located in the treatment file while 709 were outside the file. This clearly indicates a considerable success in the prevention program. The degree of success is, in fact, greater than would be indicated by the difference between the 282 "expected" cases and the 90 observed, for the 709 cases among the untreated population would probably have occurred regardless of the preventive treatment accorded the others. If, therefore, 709 can be considered the true expectancy in the untreated group, the expectancy in the treated group should be in the same proportion to 709 as 282 is to 517, or 387 cases. That is, in the absence of preventive treatment we would have expected an increase in the total cases, not merely a redistribution of them in the population. This total expectancy is 1,096 cases, and of the 387 cases which should, according to the population distribution, have occurred among those whom the state treated, 90 did occur. We may thus conclude that the immunizing treatment succeeded in preventing three-fourths of the cases which would otherwise have occurred among those given the treatment.

The method by which this evaluation of the preventive treatment was made is very general. At any time that a name file of persons given treatment is available, and it is possible to check both the cases of the disease and a random sample of the population against this file, a judgment can be made as to the effectiveness of treatment. Even if the immunization file is not complete, the method is applicable, but in that case the success of the preventive treatment will be underestimated due to the inclusion in the "nonimmunized" group of persons who have been treated and are not so listed. This factor is probably always present to some extent because of migration into the state of persons given the preventive treatment elsewhere. The effect of this is to give us conservative estimates of the accomplishment of the state program, and therefore we may consider appraisals made by this method as minimum measures of the success of the preventive treatment.

The Present Status of Public Health Education*

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PUBLIC health education has now reached a stage comparable in many respects with the adolescent period in human growth. There are signs of the emergence of a mature personality, capable of accepting and effectively discharging adult responsibilities. There is less dependence upon the immediate control of the family—namely, public health and medical science on the one hand, and education on the other. There is a tendency to adopt, sometimes indiscriminately, the dictates of outside influences; to undertake vast projects which die aborning; and to display, almost in the same breath, astounding maturity of performance and the behavior of infant days. Withal, there is a disposition to do some original thinking; to weigh cause and effect; and to find achievement under wise control. All these things are familiar characteristics of the healthy adolescent; the emerging personality gives evidence of one day harmoniously expressing the characteristics of both parents.

Public health and education, like other parents, are faced with the necessity of making important decisions. What new influences introduced into the family should be accepted, and to what extent? How are they to bring about guidance and wise control? In answering these questions, the first requirement is that the parents shall resolve their own conflicts and present a united front.

Where this coöperation has been brought about, we see public health education functioning along new lines of service to the entire community. Many official and nonofficial health agencies have joined hands with educational authorities in the development and conduct of public health education programs. Unfortunately, this kind of active, practical coöperation is exercising its beneficent influence in too few organizations.

Public health education has been defined, explored, and discussed by innumerable organizations and individuals over a considerable period. Yet, today, we do not possess sufficient data to permit a satisfactory, objective evaluation of its status. To what extent is health knowledge made available to the public through the various media of information? How are educational programs organized and administered? *What* knowledge is imparted to the public? How effective is health education in terms of providing the public with the knowledge and skills essential to health promotion? We do not have adequate answers to these questions; nor is it likely that we shall ever have complete information, since the scene is constantly shifting, and the factors

* Read at the Seventh Institute on Public Health Education of the American Public Health Association in Detroit, Mich., October 6, 1940.

worthy of specific study have as yet proved too numerous for simultaneous consideration.

In recent years, several studies have been made by the Public Health Service, designed to throw light on various facets of educational activities in the health field. The Division of Public Health Methods has explored health education of the public by means of the spoken word, through study of the home visits of public health nurses and sanitarians. In coöperation with the Metropolitan Life Insurance Company, the American Museum of Health, and the International Business Machines Corporation, the health knowledge of some 100,000 members of the general population has been tested at the New York World's Fair and at the Golden Gate Exposition in San Francisco. From an analysis of these tests, health educators may derive much needed definite information on what the public knows, or believes, and what it wants to know about matters of individual and community health.

During the past year, studies have been initiated in the Division of Sanitary Reports and Statistics which have for their purpose the securing of definite information on the educational materials provided for the public by the principal sources of health information. The first of these to be completed is the analysis of 2,500 publications on health subjects which are produced and distributed by 115 organizations. It was felt that careful study of the existing materials might provide a valuable index not only for the improvement of popular health literature and for the wider use of the most effective materials, but also an index to some of the difficulties standing in the way of healthy growth and efficient performance in other educational activities.

A true evaluation of the present status of public health education would require systematic study over a number of months, along numerous lines of investigation, in countless organizations. Nevertheless, the printed materials of official and nonofficial health agencies significantly reflect the total public health education effort, since they constitute our principal record of the information provided for the public by authoritative sources. I shall attempt to outline for you some of the more apparent barriers to effective health education of the public as revealed in our study of the printed word.

These barriers we do not believe to be insurmountable. Moreover, as regards the official agencies whose manifold functions and restricted budgets do not permit of rapid expansion in public health education, it is believed that much improvement in the educational effort could be achieved with little, if any, additional expense.

The 2,500 publications included in our pamphlet collection were contributed by 47 state health agencies, 2 territorial boards of health, 42 city health departments, 18 private organizations, and 6 federal agencies. Although neither the collection of publications nor the organizations represented include all of the materials or all the active health agencies, they are sufficient in quantity and in geographic distribution to be representative of the educational materials from the principal sources of health information in the United States.

One problem, shared to a greater or less extent by all types of organizations, is lack of coördination of the educational activities of the individual agencies. This is true of a far larger proportion of official health agencies than of private organizations. Neither federal, state, nor local official agencies escape this failure to draw together the activities of the organization in behalf of the public's health information. In state health departments and large city agencies, for example, the several divisions, bureaus, or units of the agency prepare, publish, and distribute educa-

tional materials apparently independent of central supervision. Far too frequently, such materials duplicate, overlap, or even contradict one another. In all likelihood, the total educational effort reflects the same lack of integration.

No one is more aware of the existence of this condition in federal agencies than the Division of Sanitary Reports and Statistics. During the past year, however, steps have been taken in the Public Health Service to improve the situation. The production of health educational materials by the Service is now being coördinated in the Division of Sanitary Reports and Statistics, including the preparation of venereal disease education materials. Unnecessary duplication of federal materials in the maternal and child health field has been done away with by withdrawing from publication the pamphlets of the Public Health Service on these subjects, and by referring the public in need of such materials to the Children's Bureau. Again, coöperative arrangements are being developed between the Public Health Service and the U. S. Office of Education and the National Youth Administration. These first steps do not mean that all the problems have been solved, nor that impressive results have as yet been achieved; but at least a beginning has been made.

A striking manifestation of the lack of coördination and of coöperation in educational activities among health agencies is the amazing duplication of pamphlet materials on specific subjects. More than one-fourth of the 2,500 publications in our collection are upon communicable diseases; and another 22 per cent on such impersonal health subjects as environmental sanitation and control, scientific research, organizational problems, and vital statistics. Since these are the paramount interests of public health work, the concentration of effort upon these subjects would not be of particular note were it not for the resulting dearth of materials upon other subjects of increasing public health importance, especially in relation to the health of young adults and older members of the population.

Only 36 pamphlets in the collection could be classified as industrial hygiene materials, and half of these were technical bulletins. Mental hygiene received even less attention, with only 18 publications. Together, these two problems of nation-wide, public importance were discussed in about 2 per cent of the 2,500 pamphlets in our collection.

Non-communicable diseases, including a large proportion of those which are the most frequent causes of death and others which cause a tremendous volume of disability, were discussed in only 1 out of every 16 pamphlets of our collection. For every publication on non-communicable diseases, there are 3 on environmental sanitation and more than 5 on communicable diseases.

Even in publications on communicable diseases, there is an unusual amount of concentration on particular infections. For example, there are more pamphlets on venereal disease than upon any other specific public health problem, and more than twice as many on tuberculosis as on cancer. And there are more than twice as many publications on diphtheria, measles, smallpox, or scarlet fever as upon influenza, pneumonia, or malaria.

Not only is there duplication of subject matter, but the informational effort also tends to view a wide variety of subjects as the health problems of limited groups of the population. At least half of the content in our pamphlet collection is directed toward the problems of expectant mothers, infants, and children under high school age. Even where there is a considerable amount of material on subjects of general interest—as in dental hygiene, nutrition, and personal hygiene—overemphasis upon limited groups of the population tends to weaken the

public health education effort. In dental hygiene, for example, it is difficult to capture the interest of adolescents, young adults, or older persons, by a pamphlet for parents of young children. When dental care ends with the preservation of the 6 year molar, the interest of people worried about their wisdom teeth dies.

In the printed materials of official and nonofficial agencies, we can also see the failure to define clearly the objectives of the health agency's educational program as a whole or the objectives of particular programs.

We are all, I believe, agreed that the ultimate goal of health education is to equip the public with the knowledge, the desire, and the skills needed to protect and promote their health. Immediate objectives have not been clearly defined, however. Is the objective of communicable disease education to help the public avoid these dangers and to meet them in emergency? Or is it to secure the coöperation of the family in the performance of routine control measures, *after* a case has occurred? Is the objective of cancer education to reach and bring to treatment persons with precancerous conditions as well as those who have the disease but who are relying on self-treatment or quackery for their care? Or is it to secure community support for the improvement or expansion of cancer control facilities?

In many ways and in far too many instances, the content of our pamphlets unmistakably indicates that such questions have not been answered in the preparation of educational materials.

Indeed, one cannot help being impressed by the unusual emphasis upon the promotional aspects of public health education as compared with education of the individual. At a seminar for federal informational personnel held in Washington last winter, Professor Charters of Ohio University made this distinction between "informational" activity and "educational" activity, which I believe you will find worthy of consideration.

"Informational" activities he holds to be those which seek to inform the public of the functions, facilities, and accomplishments of a particular agency; "educational" activities, on the other hand, are designed to influence the public to adopt new attitudes and new practices in relation to their own lives. When applied to public health education, the first approach, which is promotional in character, tends to make us think more about ourselves and the things we know than about the needs of the public and the things they want to know.

Both promotional and educational activities are needed to make a well rounded public health education program. Far too often, however, the promotional approach dominates the program. When this happens, we are apt to place more reliance upon publicity technics, and upon the technical and scientific knowledge which interests *us*, than upon the needs of the public as our guides to performance.

There can be but one result under such circumstances—the program is not interpreted in terms of the public's needs and understanding. What we say may not fit in with the public's way of looking at things; and, what is more important, what we say does not suggest the significance of our knowledge in relation to what the public thinks and does, as individual members of their society and their family. Our efforts to secure the public's coöperation and support may fail us because we have failed it.

In our pamphlet collection, these deficiencies are especially apparent both in the dearth of materials on subjects of interest and concern to important groups of the population, and in the way we talk to our public about problems of general interest.

In the first instance, for example, the

health problems of the industrial worker have not been dealt with in the educational program. Yet, here is a group of 50,000,000 adults with special health problems incident to their occupations. Moreover, the worker suffers far more frequently from nonindustrial illness than he does from occupational diseases. The lack of educational emphasis upon the common ailments of adults—chronic diseases, acute systemic ailments and the like—leaves the industrial worker, as well as the general adult public, ill equipped to deal effectively with these conditions.

In the second instance, there is a prevailing tendency to talk to our public about such topics of general interest as environmental sanitation, public health services, and even communicable disease control, as though they were trained public health workers. I often find myself thoroughly exhausted by the perusal of public health laws, rules, and regulations; I have to read them a good many times in order to translate to myself just what they mean. Yet, far too frequently we expect our public to grasp and interpret the language of the law or public health and medical "shop-talk."

Indeed the problems of what to tell the public, what groups need to be told, and how to tell them are even more impressive than the duplications and concentrations of interest in our pamphlet collection. We have been increasingly impressed by the unselective character of the content in relation to the needs of the public; by the conflicting opinions far too frequently expressed; and, finally, by the marked variations in the language—the literary quality, if you will—of the pamphlet literature. These factors weigh more heavily in the effectiveness of the printed word than any others. An evaluation of a select group of publications, in terms of specific content, conflicting statements, and literary style has been initiated by our Informational Section as a sequel to the completed study of pamphlet materials.

With the information now available, however, it would appear that a larger proportion of the pamphlets on dental hygiene, maternal and child health, nutrition, and personal hygiene possesses more of the desired qualifications than any other subject groups. In other words, education on these subjects appears to select the facts of immediate and practical interest to the public; to tell a more uniform story, and to tell it with greater simplicity. On the other hand, pamphlets on environmental sanitation and control and on non-communicable diseases, attempt, more than other groups, to give too many technicalities which may or may not be of use to the public, and to be more difficult of comprehension by the average reader.

Conflicting statements and opinions are prevalent in all subjects and among the several groups of agencies. For example, in 20 pamphlets on measles, 12 different incubation periods are given; and similar conflicts as to the appearance of the rash and the period of communicability occur. Such conflicts contribute to the lack of public confidence in scientific medicine and public health, and also to much of the confusion and misinformation in the public mind.

Although the primary interest of the study just completed by our Informational Section was in the subjects covered and the kinds of information provided in published materials, some of you may be interested in the physical characteristics of the pamphlet collection. About 70 per cent were printed, the remainder having been reproduced by one of the many duplicating processes, chiefly mimeographing. However, 96 per cent of the pamphlets from private organizations were printed, as compared to 62 per cent from state and local health departments, and 73 per cent from federal sources.

About two-thirds of the entire collection had no illustrations either in the copy or on the cover page. However, the proportion of illustrated pamphlets to unadorned materials is almost entirely due to the productions of private organizations, 65 per cent of whose pamphlets were illustrated as compared with 30 per cent or less among official agencies.

I believe none of us can doubt that these several problems in the preparation of effective educational materials—lack of coördination, failure to define objectives and to interpret in terms of the public's needs and interests, overduplication of subject matter and undue concentration upon limited groups of the population, and the like—reflect fundamental problems in the public health education program.

The difficulties which I have briefly discussed are shared, to a greater or less extent, by all agencies. Similarly, there are many good educational materials produced by various types of agencies, just as there are many effective educational programs in operation today. However, the problems which I have presented to you permeate the total educational effort to an extent which commands our mutual, unbiased consideration.

A very large proportion of the correspondence handled by the Division of Sanitary Reports and Statistics consists of requests for information as to where to obtain effective materials upon specific subjects and for specific groups. There exists a great volume of educational materials produced by the principal sources of health information. But the lack of specific information as to their availability tends to restrict their use in schools and other educational institutions. Moreover, interested individuals are as much or more concerned with their content, their effectiveness, and with their suitability for particular groups.

Through lack of contact with their public and with other agencies, many organizations presume existing materials to be more generally available than is actually the case. Some agencies cover a wide variety of topics with many printed materials of varied content and of varying quality; others issue very few publications on even fewer topics. The distributor may serve only a limited public, as in the case of state and local health departments which serve only their area; or the cost of publications may restrict their availability. Even where materials are distributed without cost on a nation-wide basis, as in the case of a few voluntary agencies, there must be a limit to availability, despite the generosity of such organizations. In some cases, the channels of distribution have not been explored and efficiently used; because of this, many of the most effective publications do not receive the widespread use which they deserve.

As a matter of practical and economical procedure, the time has come when health agencies should take conscious control of their educational programs, including the preparation and distribution of materials. Two urgent needs seem to be: (1) coördination, planning, and direction within the organization; and (2) the sharing of experience, objectives, and resources with other agencies. The need for real working agreements in making decisions of mutual interest as to objectives, content, and methods has been recognized by various groups in recent years. Committees such as the Conference for Coöperation in School Health Education, the joint Committee on School Health of the American Medical Association and the National Education Association, and the Committee on Coördination of Health Education are exploring some of these problems.

The lack of some mechanism—a mechanism that will *function*—whereby groups of agencies active in public

health education might pool their experiences and their resources on a continuing basis, appears to me a most important factor inhibiting healthy development in this area of health endeavor. Such a mechanism should be geared to deal with practical problems related to the evaluation of particular technics, the preparation and use of better materials, and to decisions as to the content of public health education. It should also be planned so as to profit by the training and experience of responsible persons in a variety of fields as well as by the decisions of experts in the biological, medical, and public health sciences. The Public Health Service is ready to coöperate to the extent of its facilities in any such effort to solve practical problems leading to the improvement of our own and other agencies' educational effort.

Public health and educational agencies alike will be faced with added responsibilities during the coming months and years of rapid expansion in military and industrial activity throughout the nation. Health education, particularly of young adults, is an immediate and urgent need. Responsible agencies can and must help to equip individuals and whole communities with essential health knowledge and skills. I should like to sound a note of warning against each agency striking out independently to do the job. There is work enough for all resources without duplication by any organization. In accepting and discharging our present and future responsibilities, we must first honestly face together, and in some measure remove the barriers to effective performance in public health education which I have discussed with you. I am sure that we can and will together meet the challenge.

CHRISTMAS SEALS

Help to Protect Your Home from Tuberculosis

Work of the Committee on Professional Education*

W. P. SHEPARD, M.D., F.A.P.H.A.

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DEVELOPMENT of standards for professional education in public health presents certain problems peculiar to the public health field. For the most part, our members come from varied professional backgrounds such as medicine, engineering, nursing, bacteriology, biometry, and education. Standards for their specialized training in public health must be as varied as the many ramifications of public health activities. Although we are prone to call public health work a specialty, we have had few standards for such specialization, and many of those we have still lack general public acceptance. The importance of these problems is increased with the present rapid expansion of public health personnel. Appointing authorities, to whom this new personnel apply, have had a legitimate complaint. If they accept our recommendation that public health workers should be properly qualified by training and experience, they have been confronted with the fact that we have until recently provided no means by which they can distinguish between the well trained, poorly trained, or untrained applicant.

This is not a new situation. It is one through which all the learned professions have progressed. It is within the memory of many here when medicine as a profession was in the same chaotic state. Even more recently, teaching, now one of the best professionalized groups in America, had few professional standards. Dentistry, nursing, law, and the ministry have gone through similar stages. Taking the historical development of the other professions as a guide, it is evident that these problems are best solved by the professional groups concerned. One of the most brilliant achievements of any professional group has been the development of training standards and the raising of professional competence through self-regulation by the American Medical Association. It has been far better for the physicians of the country through their own professional organization to determine and apply standards of professional competence which are in the best interests of the public. Similarly, the American Public Health Association must determine its own standards of professional competence and professional training. This challenge was accepted by the Association in 1932 when it created a fourth Standing Committee, the Committee on Professional Education.

The work of the Committee on Professional Education is being conducted by men and women of high professional

* Read at a General Session on Professional Education of the American Public Health Association at the Sixty-ninth Annual Meeting in Detroit, Mich., October 10, 1940.

standing who are working to obtain agreement on, and to raise, the educational qualifications of professional public health workers. Their work, though sometimes slow, is accomplished through painstaking effort, careful study, and broad consultation.

Self-regulation is not easy in any professional group. On the one side, it raises the fears of those who may suspect themselves of being inadequately trained. On another side, it tends to dissatisfy those with superlative training who believe that all should have similar advantages. In another direction, it dares to assail the academic stronghold of our schools with questions concerning the effectiveness of their training. It must always wrestle with the difficult problem of experience versus training. It must constantly bear in mind the dangers of over-specialization and of over-standardization so well pointed out to our members by the late Dr. Frost. And yet, with all these difficulties self-regulation must depend for any success it may enjoy upon ultimate agreement by a majority of the members of this Association. For these reasons your committee appreciates the opportunity of reporting to you on its activities and its general methods of procedure.

As to general policies, the committee is proceeding on the theory that the best of training is none too good for those who would enter the public health profession in any of its branches. It has prepared reports suggesting rather high standards of training for the various sub-specialties in the field, feeling that these high standards were worthy aims, but recognizing that their complete accomplishment may not be possible at the present time. The committee is in unanimous agreement that its reports must not remain static. They are published from time to time as the consensus of the best knowledge available at the present moment. They are subject to constant review and revision. Their revision depends largely upon the suggestions received from members, upon the comments and directions of the Governing Council, and upon changing demands in the field. The committee recognizes the necessity of patience and tolerance in controversial issues. It recognizes the importance of time in all sound professional growth. The committee hopes to deserve your full confidence, and to assist in crystallizing opinions concerning professional qualifications in this Association. According to the By-laws we are charged with the responsibility of "carrying out research and the development of standards for professional education and training in public health, and the performance of such other functions as may be delegated to it by the Governing Council with the view of maintaining professional qualifications of high standards." To these ends the committee has bent its energies in the past and during the current year.

A brief summary of the year's work is as follows:

Well over a thousand copies of the report dealing with the educational qualifications of health officers, approved by the Governing Council at our last meeting, have been placed in the hands of health officers, medical schools, schools of public health, civil service agencies, foundations, and other interested groups. This was a report of far-reaching importance to the public health profession. It has been reprinted in a number of professional periodicals, and has received widespread favorable editorial comment.

The committee has also distributed large quantities of its other reports, previously approved by the Governing Council, covering the educational qualifications of engineers, sanitarians, industrial nurses, school health educators, public health nurses, and public health statisticians.

A sub-committee has been appointed to study the educational qualifications of public health nutritionists. This committee is working closely with the American Home Economics Association, the American Dietetics Association, and the Conference of State and Territorial Health Officers. The preliminary draft of their report was approved at this meeting and it will be circulated for critical comment in the usual manner before submitting it for approval to the Governing Council.

Careful study has been given to the assistance which the Association may give to health departments introducing and operating the various forms of merit systems. This is a situation in which the federal and state health agencies are seeking to implement the ideals of career service for which the Association has long stood. The precise nature of the assistance we may be able to render is still undetermined, and depends largely upon what we are asked to do by the federal agencies and the various state health departments. It is possible that the committee can help most by preparing a manual of experience in the examination of persons for professional positions in public health, and by systematizing the nomenclature for positions in our professional field. During the year requests from several state authorities for assistance with their respective merit systems have been met, and in several instances lists of able consultants have been prepared. A sub-committee has been appointed to explore this field in order that the assistance of the Association may be as effective as possible.

Consideration has been given to the need for adequate training of administrative personnel in special fields. Our attention has been called to the desirability of providing basic public health education for industrial hygienists, tuberculosis directors, venereal disease officers, public health dentists, mental hygienists, maternity and infancy specialists, and others. The needs of these groups are being carefully studied with a view to outlining the basic training necessary for the proper performance of their duties.

The Sub-Committee on the Educational Qualifications for Public Health Nurses is working with the National Organization for Public Health Nursing to revise the qualifications for public health nurses for the period 1940 to 1945. This report is revised every five years for the purpose of keeping qualifications as high as practicable to assure well trained personnel.

The Sub-Committee on the Educational Qualifications of Public Health Laboratory Personnel has been engaged in outlining desirable training for this group of specialists. It is expected to meet shortly for a further discussion of its problems.

Educational qualifications for adult health educators continue to be studied by the sub-committee of the same name.

A Sub-Committee on Field Experience Centers has been studying the best possible provisions that can be made for a period of practical field experience under capable supervision in a well rounded health department to supplement the theoretical training provided in classroom and laboratory.

The lack of adequate instruction and training of medical students in the basic principles of public health has been repeatedly pointed out. A Sub-Committee on the Teaching of Preventive Medicine to Undergraduate Medical Students is working in this field and is developing a plan for coöperation between the American Association of Medical Colleges and the American Public Health Association.

A representative has been appointed by the committee to work jointly with the National Organization for Public Health Nursing and the U. S. Public Health Service for the purpose of ex-

amining the content of the curricula of the schools of public health nursing throughout the country.

Each year the committee has collected data on the number of students enrolled in schools of public health and the number of degrees or certificates awarded. Wide interest has been expressed in these reports, and this year's findings are published in this issue of the JOURNAL.

At the suggestion of the Committee on Professional Education and the Conference of State and Territorial Health Officers, the U. S. Public Health Service has completed an extensive survey covering the educational qualifications of staff members now in service in official health departments. This gives us for the first time accurate information on the present level of training and experience in existing personnel which may be used as a basis for further plans and programs. This study will furnish guidance for much of the future work of the committee.

The committee recognizes a problem in relation to existing and proposed future schools of public health. Some state officials object to sending public health trainees outside the state, especially where some facilities for public health training exist within the state. These officials do not always appreciate the extensive facilities and highly qualified faculty necessary for a successful school of public health. This leads to a tendency in some states to develop what must become mediocre schools of public health. There is danger that a greater number of schools may be developed than will be necessary to meet the long-time demands for trained personnel. In addition to this problem, there exists at present no standard practice or even general agreement between existing schools of public health as to curriculum content for various types of public health trainees, and no common practice as to the type of degree to be awarded for a given amount of academic attainment. Finally, there is no common clearinghouse for schools of public health in which experience may be interchanged, or where reports may be received concerning the degree of success which their trainees attain in the practical application of the principles taught in the school. There appears to be a need for some organization among existing schools of public health and for a central advisory body which will function in a manner similar to the Council on Medical Education and Hospitals of the American Medical Association. How much of this is the proper function of the Association and its Committee on Professional Education is still undetermined. Your committee is exploring this field to ascertain in what manner the Association might be most helpful.

The committee gratefully acknowledges the numerous expressions of confidence received from the members of the Association and of the Governing Council, and for the opportunities it has had to contribute to the raising of professional standards in this country. It is ever aware of the need for continued building of adequate health service manned by competent men and women. Esteem for the profession will continue as long as public health workers are adequately trained and can demonstrate professional competence. We shall continue our efforts to urge that those entering the public health profession meet the high standards for which this Association has stood during its many years' existence.

Education and Training of the Physician for a Public Health Career*

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THE feature of the Social Security Act which distinguishes it from previous federal laws for the promotion of health and the one that has paid the greatest dividends, is that which provides for the education and training of personnel. The allocation of funds under this act imposes on the health officers of the several states and their component municipalities a trust that is of primary importance. They must see that the services to be rendered are important public health services and that they are well rendered.

There is no need today to labor the point that to render a service well, to render it with efficiency and economy, requires trained and educated personnel. The training and education of physicians for a public health career, if it is to be done with public funds, properly begins with the careful selection of those to be trained and educated. The method of selection, training, and education which I am about to describe was evolved in an effort to provide primarily a reservoir of satisfactory candidates for examinations held by the New York Civil Service Department for administrative medical personnel. It is believed, however, that it is adaptable to states operating under merit systems that are not established by state law and in states whose civil service does not cover professional personnel.

While many satisfactory lists of such personnel have been furnished by the Civil Service Department, particularly when the examination was open to non-residents of the state, unsatisfactory lists have been furnished also. The latter resulted largely from the extreme difficulty of judging the personal qualifications of candidates under any system of examination. Ignorance of a subject may be determined with fair accuracy by a written examination and oral interview, outstanding character defects may also be discovered by the interview, but a real judgment cannot be made until there has been a field trial.

It is true that the Civil Service Commission of our state regards the probationary period as a part of the examination. This was extended from 3 months to 6 months for medical personnel, since we found the former period too short in which to make a judgment fair to the probationer and fair to the department. However, two difficulties arise in exercising the right to drop a candidate on probation. Under our New York State law he must be dropped at the exact end of the probationary period. His deficiencies may be apparent in a week, yet he must be kept 6 months unless he resigns voluntarily or is discharged on charges.

The second difficulty is the situation in which the probationer finds himself when he learns that his services are unsatisfactory. Perhaps he has given up a practice, or more frequently a position in some other department which

* Read at a General Session on Professional Education of the American Public Health Association at the Sixty-ninth Annual Meeting in Detroit, Mich., October 10, 1940.

has since been filled. The embarrassment of any decently human administrator on such an occasion needs no elaboration. I am not speaking here of defects which would constitute the basis of formal charges, but of those deficiencies which determine whether the quality of a department is to be mediocre, good, or very good.

While a few outstanding people may give a *reputation* to a department, it is the quality of the service rendered through all levels that determines its real usefulness to the public. It is the duty of the department head to guard this quality, to raise it if he can, never permitting it to be lowered.

The probationer may have a good record of past performance. It may be he is a square peg trying to fit in a round hole. If there is a square hole available, the difficulty may be solved, but all too often the candidate must be dropped for the good of the service.

Another reason which led to the adoption of the present New York State system of selecting medical personnel was the restiveness of the legislature over the opening of examinations to nonresidents of the state. During every session in recent years, bills have been introduced to limit all examinations to residents of the state. Such a bill passed a few years ago, and it required the veto of Governor Lehman to preserve this important right to accept candidates from other parts of the country. However, a department head is now required to certify that a satisfactory list cannot be obtained from residents of the state, if he wishes an examination opened to nonresidents. Obviously such certifications cannot be too freely used. They must be reserved largely for the positions requiring some highly technical proficiency.

A further incentive to adopt a system which contemplates the training and education of personnel is the exhaustion of the national reservoir of men already trained through the demand created by the passing of the Social Security Act. This Act had the effect not only of expanding the health services and personnel of state and local governments, but also of the teaching institutions. In practically every instance the selection of a nonresident already trained for service in New York State meant that some other state or city lost a qualified man.

The method evolved sought to avoid some of the requirements normally attaching to appointments under the Civil Service Law and the Civil Service regulations made under its provisions. We felt the need to be free from the requirement that we retain an appointee for a full 6 months period in the event that his deficiency became apparent earlier. We felt the need of a longer period of observation and training without obligation for a permanent appointment, and the need of a status which would permit a selection in the first instance by the department on the basis of a review of the applicant's educational qualifications, without a written examination, and on what we could learn by inquiry of his probable adaptability to a public health career.

It is also believed that the subsequent education of a candidate in a formal school of public health will be enhanced by his relating what he obtains through lectures, reading, and laboratory work to an experience gained in the field. The physicians selected are designated as "epidemiologists-in-training." They are in the non-competitive class of the Civil Service. The primary reason for making these positions non-competitive is that we did not want mere "examination passers." Sometimes the difficulty of an administrative medical officer is that he knows all the answers and is not reluctant to let others know that he knows. Those selected are required to have been

graduated from an approved medical school, preferably with a rating of A or B, and to have served at least one year of internship.

With rare exceptions they must be under 35 years of age. The difficulty of transforming the habits and viewpoints of persons of greater maturity entering full-time health work seems an unnecessary obstacle to overcome if promising younger material can be found. This non-competitive appointment is limited to one year, as the Civil Service Law permits no longer appointments, except for certain exempt classes.

They are inducted into service following their selection by assigning them to one of the state health districts. In order that they may have a variety of experience and that the department may have a composite opinion as to the value of the individual, they are commonly shifted to different districts at intervals ranging from 1 to 3 months. Following their primary experience in a district office, they are assigned to the central office for a month's observation of its methods and requirements.

We regard this period of apprenticeship as one in which not only we determine something of the aptitude of an individual for a career in public health, but he determines for himself whether or not it is the kind of life he wishes to lead. Very few undergraduates in medicine have a clear conception of the duties and administrative functions of the modern health department. Some are fearful of "regimentation," others that its opportunities are severely limited so far as investigation, promotion of knowledge, and the other rewards—not necessarily monetary—that private practice and teaching institutions provide.

After a practical experience, usually of from 6 to 12 months, as an apprentice, those who show promise of qualifying for positions as public health officers are given a scholastic year's fellowship at one of the postgraduate schools of public health. The choice of such schools is based, as far as possible, upon the individual's preference. We believe, however, that it is highly desirable that they enter schools having students from different sections of the country in order that they may profit through their association with men who have been engaged in health work under a greater variety of conditions than would ordinarily obtain if the students came from the same part of the country. During this period at the school of public health, in order to avoid the limitations of one year in the non-competitive class, they are designated "physicians-in-training." As students in the public health school they are required to pass the examinations of the school, and their failure to do so automatically ends their apprenticeships in the State Department of Health.

Following the successful completion of their scholastic course and the completion of the minimum 6 months of field experience as epidemiologists-in-training, they are required to take a civil service examination for one of the assistant district positions in the State Department of Health. In this examination they are in open competition with physicians having other training and education. An individual must be within the first three on any list submitted by the Civil Service Commission in order to be available for appointment. As individuals are appointed from among these three, the next lower of those who have passed the examination becomes available for appointment.

Pending the announcement of the list, they are given provisional appointments to any existing vacancy to which the passing of the examination would make them eligible. Up to this time, there have always been such vacancies, and at the current rate of depletion of the staff, their existence seems likely to continue.

It will be seen that this method is

not designed for mass education. Our purpose is to select men of character, with courage and initiative who can fill not only subordinate positions in the department, but who have the capacity to develop. This development must be not only in the acceptance of responsibility, but in a capacity to develop as the field of public health develops.

It is considered highly important that those accepted for training and education have considerable initiative, a desire to excel as exponents of their specialty, an ability to overcome the influence of a bad example, to bear up under disappointment. Civil service in New York State offers a high degree of security of tenure. There is therefore the temptation to let down to merely "satisfactory" performance, and play safe by doing just that and no more. We seek those who have that inherent spirit which keeps them striving for a better way of doing things for the sake of seeing them done better.

The district offices to which epidemiologists-in-training are assigned are chosen not merely on account of the problems which the district affords, but also on the basis of the capacity of the district health officer's ability to instruct and inspire, and our trust in his judgment of the qualities of the candidates submitted to him for training.

During the period of training, as distinguished from the period of education in the postgraduate school, the candidate is required to take an extension course provided for local part-time health officers in New York State. This is essentially a reading course of certain standard works on public health, with written assignments for review. In addition they are made acquainted with other standard works on public health and with current public health literature. The staff member in charge of the extension course for local health officers is responsible for the fulfillment of this superficial postgraduate education.

The candidates are required further to study the state laws and sanitary code, the operating rules of the department, the plan of paper work; they are expected to gain an understanding of the importance of knowing the geography, the community facilities, and the population composition of the districts they serve. There is no particular effort made to inculcate an understanding of the underlying philosophy of the rules and regulations. We assume this to be the business of the schools of public health and we are trustful that these schools are fulfilling our expectations.

The description I have just given applies primarily to the training and education of physicians for positions in our district field staff. I believe this to be the reservoir from which may be supplied the district health officers, the full-time county and city health officers, and the higher department staff officers of the future.

It is believed that, even in the specialized divisions, a sound basic training in general public health administration may be of greater value in the promotion of specialized services than a high degree of clinical proficiency. Specialization in clinical branches often leads to an individualistic approach to problems which neglects the mass problem confronting the health administrator. For this reason, a number of members of the staffs of specialized divisions have been given scholarships for general postgraduate courses in public health.

Appointments as epidemiologists-in-training and physicians-in-training are not limited to selections made primarily by the State Department of Health. We accept candidates apparently having the basic qualifications we deem necessary who are recommended by city and county health officers. It is our hope that the health officers of our cities in particular will be able to find promising

material among the resident physicians of their communities who will serve the stipulated training period and take the postgraduate courses which will qualify them for full-time work. Such physicians will thus be prepared to assume higher responsibilities in local health departments when vacancies occur.

I have not mentioned up to this point the special types of education and training provided for members of the department staff already in the State Civil Service, nor short courses provided for practising physicians in special subjects. In general, these are given in coöperation with the State Medical Society. They are described by Van Volkenburgh in a recent paper.[1] I shall refer to only one of them, since it is a new venture, though one which we hope will be highly productive.

This is a course in public administration which has been devised by the Maxwell School of Citizenship and Public Affairs of Syracuse University. It provides instruction in law enforcement methods, personnel and office management, public speaking, group leadership, news release preparation, methods of influencing individuals through personal approach, and the technic of radio broadcasting. This appears to be a field which has not up to the present been covered adequately by the postgraduate schools of public health. The course consists of a series of 2 day monthly conferences, and during the past year has been attended by 35 members of the field staff.

I have assumed in the foregoing statements that the reader is acquainted with the operation of a good civil service system; one free from political control, and endeavoring to provide competent personnel. Palmer's recently published description of the present New York City Civil Service fits, with minor exceptions, the New York State system.[2]

I think it should be realized that in entering public health as a full-time career from private practice the physician burns his bridges behind him. Unless he is just entering practice or has resolved upon a change of location for other reasons, he relinquishes something which may be of such importance to him and his family that the attendant risk of future employment constitutes an almost insuperable obstacle to self financed training and education. He should have some assurance of future employment. The Rockefeller Foundation realized this years ago when it began its grants of fellowships in public health.

We have not, however, stipulated in our understanding with physicians accepted for training that they shall continue in the service in New York State or any of its component municipalities, nor do we obligate ourselves to place them. It is conceivable that through a reduction in state appropriations or federal appropriations available to the states that staff reductions may be necessary. Therefore, we cannot bind ourselves to anything in the nature of a definite commitment. Nor do we think it is fair to the individual that he bind himself for a stipulated period of service. We assume that in our selection we have been sufficiently careful to obtain individuals whose consciences will guide them to a decision that is fair.

Finally, I have attempted to make clear that we believe training and education to be two different but related things. Training, I conceive, to be more related to technics, while education is directed fundamentally to an understanding of the underlying principles, to a development of the individual's inherent intelligence, and to stimulating a desire for further knowledge, which desire will continue through life.

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Education and Training of Personnel Other than Physicians*

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THIS is the second time that I have been confronted in Detroit with a compulsory opportunity to talk on the education and training of personnel other than physicians. The first time was at a meeting of this Association about 17 years ago, when I had more courage in my ignorance regarding the topic than I have today. At that time I ventured certain pronouncements regarding education and training which are repeated here today solely for the purpose of testing them against the progress in the intervening period and against the policies which prevail today.

The comments to which I refer were as follows:

"With the expansion in function of the sanitarian of environment, there must necessarily come a change in both the content of and the time for the training of such individuals. Such an analysis of future requirements leads the writer to the conclusion that the collegiate course must be more than 4 years, with a probable minimum of 6 years, for all students whose purpose it is to extend the years of life of man and to make those years less irksome by an attack on the physical world in which he lives. . . .

"And might we not even hazard the suggestion that elementary discussions of the anatomy, physiology, and pathology of man should find a place in the training of the engineer, as it now does, in necessarily more elaborate form, in that of the physician, whose future lies in the field of health promotion and prevention of disease." [1]

The proposals hesitantly suggested at the 1923 meeting of the Association represented at that time a major departure in point of view with respect to education, but one which was not wholly without precedent and support. In many ways the suggestions were reminiscent of the point of view and of the practices of the late Dr. Sedgwick, who for many years had emphasized the importance of training, particularly engineers and physicians, along parallel roads and for at least part of their curricula.

Today the demands of the science and the practice of public health control reinforce more than ever this earlier belief, that the training of non-medical sanitarians would require both in time and in scope more equipment than had been provided in the past.

The suggested educational requirements issued by the American Public Health Association through the Committee on Professional Education all confirm this observation. The proposals for the education of engineers, sanitarians, and sub-professionals, in 1937; of public health statisticians and of school health educators, in 1938;

* Read at a General Session on Professional Education of the American Public Health Association at the Sixty-ninth Annual Meeting in Detroit, Mich., October 10, 1940.

and of nurses, in 1939; include minimum undergraduate requirements generally of 3 to 4 years in length, plus graduate study. In most instances the total minimum term of study ranges from 5 to 6 years.

Recognition was given in these standards to the increasing necessity of superimposing upon the functional course of a specialized nature, general basic courses in biometrics, epidemiology, bacteriology, parasitology, and public health administration, particularly with respect to engineers.

Although the trends in educational requirements are generally the same in the various groups mentioned above, my later comments are restricted largely to the education of engineers, with whose requirements I am more familiar.

THE FUTURE

The problem which now confronts all those interested in the education of non-medical personnel, is what next? We are now approximately in the same position as students of medical education were when Abraham Flexner reviewed it in 1925. At that time he made the following pertinent observations, equally applicable to the education of public health workers.

"From what point of view are the problems of medical education to be studied and presented? That depends on whether medicine is conceived to be an empiric art, a science or something struggling toward scientific status. . . ."

"Modern society depends for its effective functioning on expert service. . . . Each requires its own technical discipline, but, more and more, it is obvious that professional training may be seriously crippled for the lack of a proper underpinning." [2]

It is our judgment that the answers to these questions of Flexner, with particular reference to engineering education, are clear and ought to be promptly acceptable. They are, that the non-medical sanitarian in general, of the professional grade, practises a science and requires a detailed and elaborate basic equipment as "underpinning."

If these principles are accepted the engineer must in increasing degree be provided with a strong undergraduate course in engineering in which the basic sciences are presented with comprehensiveness and strength. Upon these should be superimposed preferably in a minimum of 2 years of postgraduate work, or the equivalent in practice, essential training in the broad biological sciences so necessary to provide the engineer with an understanding of the ever expanding requirements of public health.

Professor Dugald C. Jackson of Columbia University has recently said "As long as one studies and gains additionally the benefits of life and experience, one may expect the efforts to be rewarded." This same philosophical concept was strongly raised in Flexner's observations and analyses many years ago. Unfortunately some non-medical sanitarians are beginning to inquire in an increasing degree whether this sound principle is being lost sight of in some of the recent efforts of professional workers in public health. The question may be properly raised for the Committee on Professional Education and for the Association at large as to whether a salary of $2,100 per year for a professional worker in the sanitary field, after 15 years of sound training and experience, adequately fulfils the principles of satisfactory reward for services to the public. Is a rate, furthermore, of $3,000 a year for the Chief Sanitary Engineer of a sovereign state in the United States a reasonable compliance with this philosophical principle?

If we assume that the standards of education promulgated by the Associa-

tion are essential to an adequate and efficient non-medical corps, should we not evaluate the probabilities of the acceptance of these increasing requirements for education? Can we expect young and active minds to select these fields of endeavor, when the rewards of training and of performance are so far below the theoretical expectancy?

THE DEFICIENCIES IN PRESENT TRAINING

While these matters are being given the serious consideration which they require, there are additional sins of omission in education which ought to be listed for future consideration.

Many of the efforts toward improved educational equipment do not provide sufficient time for the development of basic necessities. Attractive and expedient as short courses of training may be, they do not appear to provide solutions to this problem. They have the further danger of indicating an apparent compliance with a requirement which is not substantiated in fact. Injections of knowledge over a period of 4 to 6 weeks at high pressure are not substitutes for detailed and time consuming acquisition and digestion of scientific fact. Short courses for refresher purposes may be essential, but they have come to be accepted as substitutes for necessary and more complete equipment.

For engineers the time should come when a minimum of 2 years of postgraduate work in a Class A university should be required. This postgraduate work should be concerned, as already stated, largely with non-engineering basic biologic courses, for which time has not previously been available in the under-graduate curriculum. The understanding which these courses provide for engineering application in public health cannot be overestimated. In other words, it is increasingly apparent that the postgraduate equipment for a well trained engineer should have a greater public health emphasis than is provided in specialized functional training. Therefore, more time must be devoted to vital statistics, general health practices, epidemiology, bacteriology, physiology, and the like.

In addition, increased emphasis should be put on the problems of social organizations within the field of public health and non-medical sanitary operations. Little or no instruction is given in most courses on the economic problems of the community, on the relationship of public health endeavor to the general contests of society, and on social organization in general.

Certainly more emphasis might be devoted in formal courses to the impact of community, city, state, and federal planning on public health activities in general and on engineering work in particular.

Dr. Alan Gregg has recently pointed out the desirability of more discussion in medical schools on the historical evolution of medicine. A similar plea might be made for a greater interest in and instruction on the evolution of non-medical practice in the field of public health.

All of these additions to instruction naturally require time. They require exploration and interest on the part of teaching staffs. More important, however, they demand a recognition of the eternally expanding field of public health, in which the narrow purposes and practices of medical and non-medical sanitarians of the 90's can no longer meet the demands of modern society.

THE MEDICAL OFFICER'S FUNCTION

Dr. Godfrey has referred to "the health officers who know all the answers and are not reluctant to let others know that they know." I have heard rumors that there are such individuals. My experience without exception has been that the health officer has a sympathy

with, an understanding of, and a desire to use the values, the competence, and the experience which a non-medical sanitary worker can provide. There are some, and perhaps too many engineers, who would like to practise tuberculosis prevention, but there are probably more health officers who do not hesitate to practise the engineering arts. I have have yet to find the engineer who would risk embarking on a program of diphtheria prevention under his own steam. It is not so rare, however, that medical officers endowed with a public health degree venture to practise some of the black magic arts in the non-medical field.

Some of the non-medical sanitarians feel that a modest restriction of sphere of action, but not of sphere of influence, by the medical officer would materially raise the general level of performance of non-medical staffs. The latter require not only official high standards, but unofficial and personal sympathy with and recognition of their specialized functions.

The field of public health endeavor is so great that the opportunities for mutual coöperation are literally unlimited. The amount of work still undone is sufficient to require the forces of practically every individual responsible for a job. When a medical officer of health, however, declares that "one of the greatest misfortunes of recent years is that engineering men are showing too great an interest in public health problems," some renewed and frank arguments on the charge and its implications appear necessary. Can an engineer have "too great an interest in public health problems"?

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Public Health Degrees and Certificates Granted in the United States and Canada During the Academic Year 1939-1940

THE Committee on Professional Education of the American Public Health Association presents a report of public health degrees and certificates granted in the academic year 1939–1940. With the exception of the public health nursing tables, this report differs from reports published in previous years * in that this year the committee has included only graduate students enrolled in courses leading to graduate degrees and certificates. The basis for the record is *the number of students who have received degrees* rather than the number of degrees granted in the specified period.

Enrollment in Public Health Courses

Number of graduate students enrolled and public health degrees and certificates conferred during the academic year 1939–1940 by United States and Canadian universities. Unless otherwise indicated, courses require at least one year of residence.

TABLE I

Name of University	*Number of Graduate Students Registered*	*Graduate Degrees and Certificates Offered*	*Number of Graduates Receiving Each Degree and Certificate*
DeLamar Institute of Public Health, Columbia University	29	M.S.	24
Harvard School of Public Health	76 [1]	Dr.P.H.	4
		M.P.H.	42
		C.P.H.	2
Johns Hopkins University	124	Dr.P.H.	8
		M.P.H.	78
		Sc.D. in Hygiene	7
		Sc.M. in Hygiene	6
Loyola University	12	Dr.P.H.	0
		M.S.P.H.	0
Massachusetts Institute of Technology	19	Dr.P.H.	0
		Ph.D.	0
		C.P.H.	7

* *A.J.P.H.*, Vol. 29, p. 1338; Vol. 28, p. 863; Vol. 27, p. 1267; Vol. 26, p. 819; Vol. 25, p. 341; Vol. 23, p. 1124.

TABLE I (Cont.)

Name of University	*Number of Graduate Students Registered*	*Graduate Degrees and Certificates Offered*	*Number of Graduates Receiving Each Degree and Certificate*
McGill University	5	D.P.H.[2]	4
University of California	0[3]	C.P.H.	15
University of Michigan	181	Dr.P.H.	3
		M.S.P.H.	67
University of Minnesota	16[4]	C.P.H.	7
		M.S.	1
University of North Carolina	13	Dr.P.H.	0
		Ph.D.	0
		M.P.H.	4
		M.S.P.H.	3
		C.P.H.	2
University of Pennsylvania	16	Ph.D.	2
		M.P.H.	8
		M.S.P.H.	4
University of Toronto	20	D.P.H.[2]	20
Wayne University	2	Dr.P.H.	2
Yale University	37	Dr.P.H.	2
		Ph.D.	1
		M.P.H.	8
Total	550		331

[1] 20 were part-time students.
[2] Diploma in Public Health.
[3] Graduate courses were discontinued a year ago. However, students registered completed their courses in August, 1939, and were granted certificates in May, 1940.
[4] 4 were part-time students.

Classification of Public Health Degrees and Certificates Granted in the Academic Year 1939–1940

TABLE II

Degree or Certificate	*Number of Graduates Receiving Degrees and Certificates*	*Number of Schools Offering Each Degree and Certificate*
Doctor of Public Health	19	8
Doctor of Science	7	1
Doctor of Philosophy	3	4
Certificate in Public Health	33	5
Master of Public Health	140	5
Master of Science in Public Health	74	4
Master of Science	31	3
Diploma in Public Health	24	2
Total	331	

Graduate Students Enrolled and Degrees and Certificates Granted in Public Health Engineering and Sanitary Engineering Courses in the Academic Year 1939–1940

TABLE III

Name of University	*Number of Graduate Students Registered*	*Graduate Degrees and Certificates Offered*	*Number of Graduates Receiving Each Degree and Certificate*
Agricultural & Mechanical College of Texas	9	M.S.	5
Cornell University	1	M.C.E.	0
		M.S. in Engineering	0
		Ph.D.	0
Harvard University	47	S.M.	35
		Sc.D.	0
Iowa State College	3	M.S. in San. Eng.	1
		Ph.D. in San. Eng.	0
Johns Hopkins University	6	M.P.H.	2
		M.C.E.	1
Massachusetts Institute of Technology	8	Sc.M.	3
		Sc.D.	1
New York University	39	M.C.E.	11
Pennsylvania State College	1[1]	M.S. in C.E.	0
Rutgers University	3	M.S.	0
Stanford University	6	Eng. in C.E.: San. Eng.	2
State University of Iowa	1	M.S. in San. Eng.	1
		Ph.D. in San. Eng.	0
University of California	0	M.S.	0
		Ph.D.	0
		C.E.	0
University of Illinois	5	M.S.	2
		C.E.	1
		Ph.D.	0
University of Minnesota	1[1]	M.S.	1
		C.P.H.	0
University of Toronto	0	M.A.Sc.	0
West Virginia University	1[1]	M.S.C.E.	0
Total	131		66

[1] Part-time.

Classification of Engineering Degrees and Certificates Granted in the Academic Year 1939–1940

TABLE IV

	Number of Graduates Receiving Degrees and Certificates	*Number of Schools Offering Each Degree and Certificate*
Doctor of Philosophy	0	5
Doctor of Science	1	2
Master of Public Health	2	1
Certificate in Public Health	0	1
Master of Science	48	13
Master of Civil Engineering	12	3
Engineer in Civil Engineering	3	3
Total	66	

Public Health Nursing Degrees and Certificates Granted July 1, 1939, to June 30, 1940

More than 5,000 nurses studied public health nursing in the 26 programs of study meeting the approval of the Education Committee of the National Organization for Public Health Nursing during the year ended June 30, 1940.

The following table indicates the enrollment and the number of students who received degrees and certificates for this period. These figures have been compiled by the National Organization for Public Health Nursing and are printed here with permission.

TABLE V

		Number of Students Receiving Each Degree and Certificate		
Name of University	*Number of Students Registered*	*Baccalaureate Degrees*	*Masters Degrees*	*Certificates*
Catholic University of America	73	2	0	0
Columbia University, Teachers College	452 [1]	48	32	0
Duquesne University	56	0	0	2
Fordham University	69	2	0	2
George Peabody School for Teachers	367	18	4	51
Indiana University	54	10	0	0
Marquette University	110	1	0	12
Medical College of Virginia	31	0	0	17
New York University	1,000 [2]	40	2	0
Professional Institute, College of William and Mary	79	7	0	38
St. John's University	73	0	0	0
St. Louis University	97	6	0	0
Simmons College	213	16	0	69
Syracuse University	167	2	0	14
University of California, Berkeley	443	87	0	29

[1] Does not include registration in summer session courses.
[2] Estimated figure.

(table cont.)

TABLE V (Cont.)

Name of University	*Number of Students Registered*	*Number of Students Receiving Each Degree and Certificate: Baccalaureate Degrees*	*Masters Degrees*	*Certificates*
University of California, Los Angeles	59[1]	7	0	16
University of Chicago	53	0	0	0
University of Hawaii	10	0	0	8
University of Michigan	286	11	4	46
University of Minnesota	278	45	0	12
University of Oregon	107	34	0	49
University of Pennsylvania	283	4	0	29
University of Washington	132	53	4	25
Vanderbilt University	42	5	0	16
Wayne University	472	7	1	35
Western Reserve University	133	12	0	42
Total	5,139	417	47	512

[1] Does not include registration in summer session courses.

Students taking postgraduate work in public health nursing are increasing. Figures as nearly comparable as possible were secured for the year ended June 30, 1938. The following comparisons are of interest.

TABLE VI

	1939–1940	*1937–1938*
Individuals enrolled	5,139	3,700
Baccalaureate degrees granted	417	238
Masters degrees granted	47	17
Certificates granted	512	422

W. P. SHEPARD, M.D., *Chairman*

Report of the Chairman of the Executive Board to the Governing Council*

LAST October, at our 68th Annual Meeting, the American Public Health Association adopted a resolution declaring that peace is essential to public health progress. We reaffirm that belief, expressing our gratitude that by the grace of God we can report a year of peace-time activity in the United States, in Mexico, and in Cuba, and our sorrow that our Canadian colleagues have been bereft of this blessing.

Now our national capacities are devoted to furthering the defense movement initiated by the United States Government several months ago to insure peace in this hemisphere. Total defense is our continental objective. Public health is an essential ingredient of defense, not only public health as we know it in our work today, but in the full materialization of the concept —public health for three-thirds of the nation. Such total defense must concern itself with and provide services and facilities for the health protection of every inhabitant of North America. Only so shall we have a defense based on a people with sufficient vitality to realize our true goal, total peace.

We in the United States, together with our neighbors to the north and south, recognize that our mutual ideals demand a united defense. For public health unity, the American Public Health Association through amendment to its By-laws at this meeting, proposes to extend its Fellowship to include the health workers of all the Americas. We ask the Americas to join in a concerted effort toward the achievement of a defense which rests on a healthy people with the common objectives of freedom and social progress. To them we offer our experience and of them we ask full participation in our common task.

Our defense includes the training of large numbers of men transplanted from their usual environment into concentrated areas. The Surgeon General of the U. S. Public Health Service recently stated the problems which may face this profession in the event our man power is mobilized. Much of what he says is pertinent to other North and South American countries. He points out that traditionally we have been servants of peace, but that in these times of international conflict the developments of the medical sciences have expanded the scope of what doctors and public health workers can do for preparedness.

Dr. Parran reminds us that in times of stress the health problems of the military and civilian populations are inseparable. He has stated that none of the official agencies now have the benefits of a full working relationship with the great voluntary associations for health and welfare in which specialists in their technical capacities work side by side with citizens to spot leaks in the hull of our national man power.

* Presented at the Sixty-ninth Annual Meeting of the American Public Health Association in Detroit, Mich., October 10, 1940.

Although we have the most efficient industrial machines in the world, we still lack a comparable efficiency in the men and women who man machines, and the improvement of the health of industrial workers is an outstanding necessity today.

The Surgeon General also points to the need for listing and classifying all professional and technical personnel so that the recruitment and mobilization of medical and health staffs can be expedited.

Dr. Parran names the venereal diseases, tuberculosis, malaria, mumps, meningitis, and influenza among outstanding conditions which are of increasing importance in today's public health.

Important to the health of our people is the problem of medical, sanitary engineering, dental, and nursing staffs which will need to be drawn from civil practice to supply the needs of the armed forces.

These examples seem now to encompass a limitless job, but they represent in reality a composite of measurable tasks.

"If our democracy is to stand, we, as doctors, as health officers, as health workers, as citizens of our own free will because we know it is necessary must put medical science to work now fully to make our men as good as our machines."

Already, and over a period of several months, the Association has been called upon to clear a number of important matters dealing with national defense. It has advised with the American Red Cross and has assisted in the registering of available personnel in several categories of subordinate technicians and in the sub-professional levels. An effort has been made to keep abreast of the registration undertaken by such agencies as the American Medical Association, the American Society for Civil Engineers, the National Organization for Public Health Nursing, and others. All requests from official agencies for assistance in services of listing personnel have been promptly met.

As this report is written, a proposal is before the Executive Board looking to the appointment of a responsible Association committee on defense, expecting that it would be suitably interlocked with other committees of corresponding professional groups in order to avoid duplication and to accomplish the full purposes of the defense effort.

The Executive Board will recommend to the Governing Council that it be authorized to lend full Association aid in order to strengthen and sustain intelligent governmental effort for national defense. It is recommended that the Governing Council express on behalf of the entire Association support for an adequate defense program in which the constructive values of public health may be fully realized, not only in those defensive forces which may be mobilized, but in the basic resources of health in the entire population where lies the core of national defense.

These are controlling circumstances which face us today in the profession of public health. It may be that the requirements of public funds for the armament aspects of defense may become so acutely pressing that the provisions for civilian public health will suffer. But from every aspect, adequate provision for total public health is now more important than ever. The public health profession must join with intelligent citizens in making this fact emphatically apparent.

This continuing crisis may well affect administrative procedure. The demands of an expanding military organization may subtract the best trained and most effective administrative personnel from departments of public health, since the qualities that make them outstanding in ordinary times are highlighted in extraordinary times and

circumstances. Aggregations of large numbers of young men are sure to bring back into administrative practice a new realization of the importance of diseases such as measles, mumps, and meningitis, which took such terrific toll in 1917 and 1918. The prevalence of a preventable disease during a crisis is sometimes more serious than the loss of a battleship. That we are becoming increasingly aware of the need for special methods to handle emergency situations is evidenced by the action of the American Red Cross and Harvard University in establishing a unit in London to study the control of communicable diseases in wartime. Just as the Army has its high officials watching the military tactics of the Battle of Britain, so the public health profession has its strategists watching the third of the Four Horsemen.

For adequate protection of both the armed and civilian forces, there must be close liaison and coöperation between military authorities and local health officials, including state, county, and municipal health officers. This is so obviously true with regard to control of the venereal diseases, it is not likely to be forgotten. It is equally true with respect to the gastrointestinal diseases, and the other diseases mentioned. Defense necessity cannot tolerate mediocre health services at local levels, especially under the extraordinary demands of the new mass methods in warfare. Civilian health officials must know the health problems created by the presence of a large number of troops in their jurisdictions. Relationships based upon full understanding between civilian health officials and Army officers in charge of the health of the troops are of the utmost importance.

It is ironic that the "stately purposes" of our profession are now directed in many countries, of necessity, toward salvaging what remains after destructive forces have been at work. It is ironic, too, to reflect that the hideous efficiency of modern warfare is undoubtedly producing in these countries an efficiency unequalled heretofore in organizing and conducting emergency services for combatants and noncombatants alike.

As successful war maneuvers in our time seem to depend upon the degree of coördination between land, sea, and air forces, it probably follows that the effectiveness of the mercy squads depends upon the coördination of medical, nursing, and engineering facilities.

Planning for defense involves the acquisition of materials and men for the making of war, of machinery and personnel for the alleviation of the effects of war, and the knowledge of how to put all the factors into vigorous action—whether they stand idly by forever, as is our earnest hope, or whether it is necessary to use them.

If this introduction to a report of the Executive Board to the Governing Council appears to be preoccupied with developing events rather than with an account of our stewardship, it is because these events cannot fail to affect profoundly our profession as it is organized in the American Public Health Association. In looking back over the past year, we have attempted to reduce the Association's multitudinous activities to succinct accomplishments and to select certain highlights indicative of trends, always with an eye on the actual performance and the spirit in this organization ready for a defense program.

It is difficult to handle the highly varied and volatile material that constitutes any year in the Association's history. Much of importance evaporates before it can be recorded. Even with the evaporation process continually operative, an entire volume of the *American Journal of Public Health*, plus the *Year Book*, plus the thousands of other pages produced since last Octo-

ber offer insufficient space to capture what is left of a year's work. We point with pride to the *Journal*, now in its 30th volume, as the universally recognized medium for exchange of information and for the instruction of health workers on this continent. Its value in a defense program is unmistakable. We congratulate again its editor, Dr. Mazÿck P. Ravenel, on his sixteen years of devoted service.

The *Journal* and the *Year Book*, and all the publications of the Association represent the voluntary labor of the members of the Association, of whom there are now 6,900. About 14 per cent of these, nearly 1,000, occupy official positions of some sort in the organization, the great majority as members of our 98 technical and administrative committees. The total membership grows healthily from year to year, and the Fellowship and Life Membership gradually increase. The Governing Council has before it at this meeting 123 Fellowship applications and 36 applications for life membership, reflecting a most encouraging tendency toward career service. Where else but in the ranks of the American Public Health Association would be found the leaders and the workers, the experience and the background to project the public health aspects of a defense program?

Full documentation in regard to the 98 committees referred to is in the Association files and in the *Year Book*. An appendix to this report carries abbreviated accounts of a number of them. Some of their published and unpublished studies have the utmost significance in planning and maintaining national defense, especially those of the Industrial Hygiene, Laboratory, and Engineering Sections. The affairs of the Committee on Administrative Practice, Committee on Hygiene of Housing, and Committee on Professional Education will be reviewed in special sessions this week. Their place in the national effort is obvious. Three of the Standard Methods Committees of the Laboratory Section will soon produce the result of their labors through the publication of new editions of *Standard Methods for the Examination of Water and Sewage*, and *Standard Methods for the Examination of Dairy Products*, and of the first edition of *Standard Methods on Diagnostic Procedures and Reagents*—more important in their subject matter than ever in the great dislocations which may result from mobilization.

Many other activities of the Association have implications for the defense program—the Employment Service for recruiting personnel, the Information Service, our highly important Annual Meeting for securing unity of thought and action in public health undertakings, and the meetings of our Western and Southern Branches for similar purposes in regional areas.

There are some items which must be reported to the Governing Council outside the field which we have been exploring.

MERIT SYSTEMS

A year ago Congress amended Title V of the Social Security Act to require that personnel in the states supported by these funds should be protected by state merit systems. Almost half the jurisdictions were under existing civil service regulations, and the other half had to set up merit systems for themselves, sometimes in conjunction with the old age and public assistance aspects of the Social Security Act—sometimes separately.

All jurisdictions but one have now submitted proposals for merit systems to the Children's Bureau and a substantial number have been approved. The process of classification and examination of the existing situations is under way, together with the recruitment of qualified personnel.

Although the amendment does not apply to Title VI of the Social Security Act, the Surgeon General has issued an order which in effect makes the same restrictions cover all funds spent under the auspices of the Public Health Service.

The American Public Health Association has received a request from the federal agencies for assistance, with special reference to recruitment, the preparation of examination methods and material at the professional level, and the preparation of a "frame of reference" covering all titles in the public health service.

It is refreshing to see the federal agencies at this critical juncture standing their ground against any and all efforts to sabotage or weaken the program.

ASSOCIATION EXHIBIT AT NEW YORK WORLD'S FAIR

There has been on display at the New York World's Fair 1940, in the Medicine and Public Health Building, an entirely new exhibit sponsored by the American Public Health Association. It will be recalled that contributions of the membership made an exhibit possible during the first season of the Fair. This year it was redesigned, constructed, and maintained without additional cost to the Association through the generosity of the American Museum of Health, Inc. Presumably this exhibit will be removed at the conclusion of the Fair to the permanent building which has been assured to the American Museum of Health by the authorities of the City of New York.

FINANCIAL STATUS

The financial situation of the Association gives cause for satisfaction. The year ending December 31, 1939, saw a small surplus, and to August 31, 1940, both estimates of expense and income have kept approximately within the budget adopted by the Executive Board on December 18, 1939, which anticipated total expenditures for the year of $161,460, and total income of $161,550.

ACKNOWLEDGMENTS

Dr. Ferrell last year said in his report "The voluntary contributions to the American Public Health Association really make it the influential service organization it is, and it is appropriate that I should congratulate those who have given service, whether members of the Governing Council, the Executive Board, the sectional committees, the standing committees, or in some other capacity." To that gracious acknowledgment, I should like to add thanks to the providers of funds for Association purposes without which a good deal of our work could not have been done this year, or any year. These donors include the W. K. Kellogg Foundation, the Metropolitan Life Insurance Company, the Milbank Memorial Fund and the John B. Pierce Foundation, the Commonwealth Fund, the Charles H. Hood Educational Trust, and our sustaining members. It is hardly necessary to identify for this group the projects for which these funds are used. In the order given, the grants are utilized for the Rural Health Conservation Contest and the studies of the Committee on the Evaluation of Administrative Practices, the City Health Conservation Contest, the Committee on the Hygiene of Housing, State Health Studies, Committee on Community Organization for Health Education, general Association purposes. Thanks must be tendered also to the service organizations which continue to advertise in our *Journal* and to exhibit at our Annual Meetings.

ABEL WOLMAN, Dr.Eng., *Chairman*

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HEALTH PREPAREDNESS

REGISTRATION for the Selective Service draft is upon us and preparations are being made for the draft if and when necessary. The shadow of war—even total war—is over us for the first time in our history. It has been repeatedly said, and truthfully, that the most important single resource of any country is man power, and it is that fundamental resource that we are concerned with here. It has been often said there is no medical man on our National Defense Council. However, we have already pointed out,[1] the American Medical Association, in June, appointed a Committee on Medical Preparedness, on which there is a member of our Association, who is a doctor as well as an authority on public health.

On September 19, 1940, an order was signed by the President establishing as a subordinate body to the Council of National Defense, a Health and Medical Committee. This committee consists of Dr. Irvin Abell, as Chairman, the Surgeons General of the Army, the Navy, and the Public Health Service, and the Chairman of the Division of Medical Sciences of the National Research Council. The duties of this committee are to advise the Council of National Defense concerning the health and medical aspects of the national defense and to coördinate health and medical activities which affect national defense. The committee is authorized to utilize laboratories, equipment, and services of the medical departments of the Army, the Navy, the Public Health Service, and other government institutions, and within the limits of appropriations allocated to it, to make contracts with educational or scientific institutions and individuals for studies and investigations. This action has settled the repeated criticism that there is no physician on the National Defense Council.

Two important meetings concerned with medical preparedness have been held, one on September 16, in Washington, D. C., when the Surgeon General of the Public Health Service called the State and Territorial Health Officers in conference, and the other in Chicago at the headquarters of the American Medical Association on September 20, 1940. The points brought up and the discussion on them were searching and enlightening, but here we cannot do more than touch on some of the high points.

At both meetings figures given by Surgeon General Parran were discussed. The Selective Training and Service Act contemplates the registration of some 16,500,000 men with the immediate physical examination of from two to four million. There will be 100 induction boards to make final examinations before the men are sent into cantonments, and on each board there will be an orthopedist, a general surgeon, three internists, two ophthalmologists, one otolaryngologist, one neuropsychiatrist, one clinical pathologist, and one dentist. X-ray examinations of the chest will be made only when necessary to determine the physical fitness of a man, and only examinations of sputum and urine will be made. After induction a general x-ray examination is proposed, for which 100 x-ray machines have been ordered and will be delivered within 6 months. The U. S. Public Health Service has undertaken the collection of bloods and serological examinations. On the basis of estimated infections in the civil population of draft age, among the 16 million men there will be 300,000 cases of syphilis in the infectious stage, "a case finding program of proportions never before contemplated."

A great and immediate problem is the handling of the sanitary and health emergencies of mobilization and the movements of bodies of troops in many states. Industrial mobilization and expansion offer other great problems—the care of accidents, disease and physical impairment. As pointed out by Surgeon General Parran, we are not prepared to protect men working in the new and hazardous processes being introduced nor to alleviate the burden upon housing, medical and health facilities made necessary by the population shifts.

A most important question is exemption of medical students, interns, and residents. The Selective Service Act exempts young men in universities in training for degrees in science, and many medical schools do not graduate until the internship has been completed. However, Colonel Spruit, medical adviser to the joint Army and Navy Selective Service Board, in attempting to answer the questions asked, read parts of the law, and said that as the matter now stands, "exemption" or "deferment," two words used in the law, will be largely a matter of interpretation. He pointed out that there are 23 ROTC units in the country and that the men in their junior and senior years are exempt from registration. Students entering college courses will not be called until July 1, 1941, though they must register. He said that if he understood the law correctly, ROTC medical students do not have to register, the assumption being that they will go into the Reserve Corps on graduation. With the experience of the English during the World War, and ourselves to some extent in our own country, it is inconceivable that the training of medical students will not be continued uninterruptedly though at present the law does not seem to be clear on the subject.

A Nursing Corps for National Defense was organized some two months ago. The first project is a nation-wide census of registered nurses to determine which are available for military and which for civilian duty in their homes or elsewhere. Our Public Health Service has been asked to serve as official sponsor of this survey.

There is no ready information on the sanitary engineering personnel in the country, but this is being considered. We have no definite information on the quantity and quality of clinical laboratory service, nor do we know how many laboratory technicians can be spared for military service without crippling existing laboratories. We are also without comprehensive knowledge concerning local health organization, and we need data on the local health control of food supplies, "including milk; housing facilities; refuse and garbage disposal; medical services,

including physicians, dentists, hospitals, and clinics; local public health organization; industrial hygiene facilities."

It will be seen that there is an enormous amount of work to be done, but, as already pointed out, the medical profession will be prepared. Since there has been no appropriation for such service, it is interesting to note what Colonel Spruit says concerning the policy of the Selective Service: "There is a strong feeling in Congress and throughout the Nation that, inasmuch as men are being called to military service at great personal sacrifice, Selective Service officials should be men willing to make an important sacrifice by contributing voluntary service, and that a process based on the devotion to the national interest should not deteriorate into a job-holding organization." Physicians and public health men have always shown such a spirit and no doubt will respond in the present emergency.

PREVENTION OF RABIES

IT is just 60 years since Pasteur began his monumental work on the study of rabies, and 55 years since his first success was achieved in protecting a person (Joseph Meister) bitten by a rabid dog, by the use of his vaccine. In the meantime Pasteur Institutes have been founded in many parts of the world, and it has been estimated that considerably more than a million persons have received the treatment. The value of it has been accepted as a fact following careful experimentation and observed practical results.

Study of the disease and attempts at improving the original method of Pasteur have been carried out by many scientific workers but until fairly recently no serious doubts have been brought forward as to the essential soundness of the practice and the value of its results.

In this country a rather lively discussion has been taking place, aroused by the answer to a query in the *Journal of the American Medical Association*[1] in which cauterization of the wound by any method was advised against, and furthered by an excellent report on a study made by Denison and Dowling[2] on rabies in Birmingham, Ala., from which they concluded that the value of the vaccine treatment was exaggerated, since of 48 persons who died of rabies, 23, or 48 per cent, had received prompt and adequate preventive inoculations. Both the answer to the query and the paper mentioned called forth a number of replies, taking exception to some of the statements made. Denison and Dowling "are especially concerned with those problems which confront the physician; namely, the value of antirabies vaccine and indication for its administration." They condemn "indiscriminate" vaccination, with which all will agree, and lay stress on the importance of controlling the dog, with which also everyone must agree. Some other points are more open to question. Pomeroy and Swartout[3] have subjected the paper to critical analysis, and do not agree with the conclusions or the grounds on which they are based.

Concerning the value of cauterization of the wound, Denison and Dowling, Kellogg,[4] Pomeroy,[4] and Gloyne,[5] disagree with the *Journal of the American Medical Association,* advising strongly the use of nitric acid, in which many others, including the writer, agree. However, a warning must be given. Cauterization, no matter how effective, must not be relied upon entirely, and whenever the skin is broken the Pasteur treatment must be begun at once. This is pointed out forcibly by Muckenfuss,[4] whose statement we endorse: "I myself am unacquainted

with any bite of a known rabid animal resulting in a definite wound which should not be followed by antirabies vaccine."

As far as the Pasteur treatment is concerned, perhaps the most reliable figures are those kept by the Pasteur Institute in Paris, in which every attempt is made to determine whether the biting animal was positively rabid or not. These reports as well as those from other Pasteur Institutes in various parts of the world have for a number of years been summarized and analyzed by statisticians for the League of Nations. The Eighth Analytical Review of Pasteur Institutes, 1938, gives for 1935, 123,040 cases treated, with 332 deaths, or 0.27 per 100. The 8 reviews so far published include 758,182 cases treated, with a total death rate of 0.36 per 100.[6]

It is pointed out that results are constantly growing better. In spite of the objections which have been raised to the treatment, the acknowledged failures in a certain proportion of cases, and the paralytic accidents which occur as a result of the injections, we would fail in our duty if we did not advocate as strongly as possible the administration of the Pasteur treatment in all cases bitten by rabid animals whether or not thorough cleansing, as advised by the *Journal of the American Medical Association,* cauterization by any agent, or any other method of local treatment has been carried out.

Everyone who has had anything to do with the administration of the Pasteur treatment has met persons with an abnormal fear of rabies who are not amenable to reason or advice and who, often backed by relatives, demand treatment. In such cases it seems justifiable to administer it, or better, as has been done, to inject salt solution. The danger of treatment paralysis exists and must be acknowledged. However, it is slight. Among the 758,182 cases reported above, there were 13 cases of treatment paralysis, or 1 for each 10,729. There were only 4 deaths.

It would be foolish to say that the last word concerning rabies and the Pasteur preventive treatment has been said. There is much to be learned. Studies are going on in this country in several institutions which will no doubt give us further light. Much information has already been gained in some of these studies though publication has not been, and will not be, made until completion of the work. From other places, notably the Rockefeller Institute, in New York, enlightening material has been given to the profession. We can mention here only the development by Webster [6] of a reliable test in the mouse for the estimation of the potency of antirabic virus. This is a long step forward in giving accurate data for the determination of values now in dispute.

In the meantime it is a part of wisdom not to discard methods which in the opinion of countless scientific men have given good results in the saving of life.

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THE AMERICAN MUSEUM OF HEALTH

THE American Museum of Health, which won its spurs during the New York World's Fair, is taking over as a permanent home in the new Flushing Meadow Park, the former site of the Fair, on the development of which New York City intends to spend more than two million dollars, the building which housed the Masterpieces of Art Exhibit, which is admirably adapted to museum purposes. The splendid collection of material has been transferred from the Medicine and Public Health Building for permanent display in the Museum. The Museum, by the terms of its contract with the city, has pledged itself to coöperate extensively with the Department of Education and the Department of Health. As a semi-official institution, it will have a continuous load of visitors from public, private, and parochial schools, with which organizations it will jointly plan a health education program.

The outstanding interest shown in the Medicine and Public Health Building during the World's Fair demonstrated the wide appeal of this type of education. There was a total of 11,800,000 visitors, or about 27 per cent of the total paid attendance. It proved the practicability of the museum technic as a vehicle for the mass dissemination of health information that has been lacking in the field. The American Museum of Health fulfils the need for an efficient method of distributing the fruits of medical progress among the people.

During the Fair, the Medicine and Public Health Building functioned as a tremendous laboratory where pioneer experimental studies were carried out on visitor reaction and on exhibit technic. A vast amount of clinical data has been assembled in the past two years which will provide criteria by which the Museum will be guided in setting up its permanent displays. Embarked upon a permanent exhibit program, it will undertake other closely related aspects of health education.

Credit for original spadework in developing the idea must be given to the American Public Health Association, which in 1930 set up a committee under Victor G. Heiser, M.D., to study the problems involved and to encourage the organization of museums of health in America. This committee effected a natural coalition with the New York Academy of Medicine, which for years, through a committee under the chairmanship of George Baehr, M.D., has promoted plans for a medical museum in New York City. This coalition was aided by agencies of the National Health Council, the American Medical Association, state and local medical societies, and developed the exhibit on Medicine and Public Health which was shown by the Museum at the New York World's Fair.

The new Museum has been fortunate in the character of its financial sponsors. The Carnegie Corporation, the Josiah Macy Jr. Foundation, the Metropolitan Life Insurance Company, the New York Life Insurance Company, the Aetna Life Insurance Company, the Connecticut Mutual Life Insurance Company, the Guardian Life Insurance Company, the John Hancock Mutual Life Insurance Company, the Provident Mutual Life Insurance Company, and the Travelers Insurance Company made it possible for the Museum to establish itself soundly by their generous grants of money. The exhibit devoted to human physiology which was featured in the Hall of Man, and which now forms the nucleus of the permanent exhibit, was the gift of the Oberlaender Trust, of Philadelphia. The sponsored exhibits that made up the Hall of Medical Science were the gift

of the 21 pharmaceutical houses, philanthropic organizations, and medical and health associations represented in the Medicine and Public Health Building.

Mayor Fiorello H. LaGuardia is a member of the Board of Directors and one of its staunchest supporters. Through him the Museum obtained not only the support of the New York World's Fair, but also its new home in Flushing Meadow Park. The group of executives who tirelessly nurtured the Museum idea to reality included Louis I. Dublin, Ph.D., and George Baehr, M.D., Chairman and Vice Chairman of the Board of Directors; George McAneny, its President; Victor Heiser, M.D., Malcolm Goodridge, M.D., David J. Kaliski, M.D., Sam A. Lewisohn, James Marshall, Seth M. Milliken, M.D., Frederick Osborn, John L. Rice, M.D., George Vincent, Ph.D., Livingston Farrand, M.D., and Homer N. Calver, Secretary and Acting Director of the Museum, who for seven years was the Executive Secretary of our Association.

It is the aspiration of the American Museum of Health to provide, by its demonstration, the inspiration necessary for the expansion of the health museum idea on a national scale to which concept the Association Museum Committee is dedicated. Already a step has been taken toward this realization. Late last month the first regional museum opened its doors to an eager public in Cleveland. The Cleveland Health Museum is the fruit of happy coöperation of the medical profession, health associations, the health department, and various public spirited individuals and organizations in that city. Leaders in the enterprise were Lester Taylor, M.D., James A. Doull, M.D., Howard Whipple Green, Richard A. Bolt, M.D., H. Van Y. Caldwell and Mrs. Francis F. Prentiss, who presented her mansion on Euclid Avenue for the Museum's use. The Cleveland Museum is under the capable direction of Bruno Gebhard, M.D., who, formerly of the German Museum of Hygiene in Dresden, received his first experience in this country as Technical Consultant to the American Museum of Health. Coming on the heels of the announcement from the American Museum of Health, this news out of Cleveland indicates that the museum of health idea is acquiring momentum, and it will be only a matter of time before other progressive cities adopt it. Thus, the seminal work of the American Public Health Association bids fair to become reality.

We can rest assured that the American Museum of Health, under its competent leadership and with the active coöperation of all public health workers, will continue the splendid work in the preservation of health and the conservation of life which it initiated so auspiciously during the World's Fair years. We predict and wish for the American Museum of Health a long, fruitful life in the service of man.

Credit Lines

A Selective Digest of Diversified Health Interests

D. B. Armstrong, M.D., and John Lentz, M.S.

Bigger and Better

THE curtain had barely descended on the Seventh Annual Health Education Institute in Detroit before the inevitable question was asked on all sides: "What did you think of it?" The answers overheard were decidedly favorable, and the editors of this section are among those who willingly joined the chorus of praise. Institutes of previous years offered much that was worth while to those in attendance, but the 1940 Institute reached what seemed to us an all-time peak in the presentation of informative and stimulating speeches, discussions, and papers. A detailed record of the subject matter discussed during the sessions will be distributed at a later date to those who were in attendance. Many of our colleagues, however, did not attend and will receive no information on the Institute, and for this reason "Credit Lines" wishes to devote most of its space in this issue of the Journal to a thumbnail summary of the proceedings.

Over 300 students were registered, and a more alert and eager group has seldom been assembled. This was demonstrated time and again when speakers happened to move from the range of the microphone. Immediately cries of "We can't hear—we can't hear!" were set up—thus demonstrating that the audience did not want to miss one word of what was being said. It was especially encouraging to note the number of new and young faces present at the Institute. When the sessions finally ended, one saw bulging notebooks and file-cards packed with information. Here was concrete evidence that the Institute had supplied its students with a wealth of material. If the information thus recorded is put to use in all the localities from which the students came, the Institute's purpose will be fully achieved. Dr. Ira V. Hiscock, incidentally, stated the Institute's purpose in these words: "This Institute is held for two reasons: (1) To enrich our thinking by drawing upon the experience of our associates; (2) To share this knowledge in order that all of us may look at our jobs with a broader viewpoint."

The program embraced so many interesting features that we darted, gadfly-like, from one discussion group to another in order that we might sample all the Institute's wares. It would be difficult to select the outstanding feature of the Institute, for in every quarter we found worth while proceedings under way. Nevertheless, it seems to us that Dr. W. W. Bauer's paper entitled "The Philosophy of Health Education" is worthy of special mention. It was one of the most studious, constructive, and learned presentations that we have heard at this or any other Institute. Dr. Bauer stressed the fact that health education must be done by earnest people, that the profession has no room for the dilettante. "More earnestness, less lip service," said Dr. Bauer, "is needed." And with this we fully agree. The philosophy of health education was outlined by Dr. Bauer

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in a very novel fashion. He pointed to the following as the chief factors that enter into our philosophy:

*H*onesty	*E*fficiency
*E*arnestness	*D*iplomacy
*A*ccuracy	*U*nanimity
*L*ogic	*C*ulture
*T*enacity	*A*daptability
*H*umor	*T*echnique
	*I*ngenuity
	*O*bjectivity
	*N*ovelty

A word about Dr. Bauer's delivery is in order, for more speakers like him are needed in health education. He plunges into his subject with enthusiasm and snap and, from his opening sentence to his closing remarks, his material is delivered neatly, precisely, and impressively. In fact, his speech-making is so perfect that we feel Dr. Bauer must be wired for sound! This particular Institute paper was spiced throughout with wit and wisdom and we urge the readers of this section not to miss it when it is published in the JOURNAL at a later date.

Dr. C. V. Akin's * paper entitled "The Status of Public Health Education" left the audience with a full measure of things to think about. The data upon which this paper was based stemmed from an analysis that had been made of 120,000 health pamphlets and 160,000 health quizzes. Some of the facts that came to light as a result of this study prove that there are many loose ends in health education that need to be gathered up. For instance, we whose watchword is accuracy were abashed to learn that we are not always guiltless of making conflicting statements in the printed material which we distribute to the public. This was borne out by a study of 15 measles pamphlets in which 4 different incubation periods were cited. Such inconsistencies in our work is enough to create a lack of confidence in our efforts on the part of the public. Dr. Akin's study clearly indicated that we health educators need to get together for closer coördination and planning to forestall the appearance of such misleading statements in our literature and to avoid duplication of material. A proposal was made that we establish an agency in which information as to our resources might be pooled and shared. Undoubtedly this would be a step in the right direction, and it is one which the National Health Council has at times explored, not getting very far because of inadequate facilities.

A great deal of interest centered around Dr. Bruno Gebhard's paper called "Grandma Is Not Always Wrong." This was a timely and clever presentation. Dr. Gebhard suggested that we cease centering our efforts upon the so-called "average man" and focus our attention on grandma who is the personification of the family—and it is the family as a unit that we want to reach with health education. One of our jobs, then, is to convince grandma that our wares are genuine, but grandma is something of a skeptic. And justly so, because in her lifetime she has seen the truths of today become the errors of tomorrow. Grandma, for instance, has seen the fundamentals in baby feeding change at least three times; she has seen so-called tuberculosis "cures" come and go; and she has seen pasteurization denounced at first and recognized later. And now she hears about our vitamins, glandular therapy, x-rays, and sera. She is proud of this progress, but still she remembers some of the glowing claims that we have made in the past and so she takes our present claims with a grain of salt. Dr. Gebhard

* See page 1436, this issue.

suggested that we keep grandma in mind and go more slowly in popularizing discoveries before they are sufficiently established to warrant our telling the public about them. If we can convince grandma that our methods are worth adopting, then we shall not fall short of our goal—for the mothers and grandmothers are the members of the family circle who keep the family clean, watch for the first signs of illness, call the doctor, and do the nursing. In other words, it is grandma who puts into practice what we preach.

Dr. C. E. Turner's paper entitled "The Organization of Public Health Programs" was studded with pertinent information. Among other things, we especially liked Dr. Turner's timely reference to the relation that exists between democracy and the solution of health problems. To illustrate this, the author took as a hypothetical example a school group interested in solving a health problem. The group might attempt a solution on its own but, failing to solve the problem, the health department's help would be sought. The health department, in turn, with its trained personnel, would find the needed solution. Thus we have a case in which one group turned to a related group and found the necessary solution. The group that was helped becomes the champion of the health department and stands ready and willing thereafter to urge the department's expansion as to duties, personnel, budget, etc. It is through such democratic processes that faith in health agencies grows, and in a democratic society nothing counts for more than such coöperation.

The various Institute clinics were lively and thought-provoking affairs chiefly because discussion leaders were faced with alert audiences which directed a volley of questions at them. In these meetings, we learned about the health detectives which Dr. Mayhew Derryberry set upon the trails of thousands of World's Fair visitors for the purpose of finding out why people act the way they do and get the ideas they get when viewing exhibits. This clinic proved conclusively that we know comparatively little about exhibits, and it was suggested that any young health educator looking for a specialty might do well to devote his career for a time to the why's and wherefore's of health exhibits. We also heard pleas for greater simplification of our literature in order that the language of professionals might be made crystal clear to those on the lower mental rungs. We were reminded that we are growing both mentally and physically; that our vocabulary has expanded to such an extent that we now have a health education vocabulary born of medicine, sociology, psychiatry, pedagogy, and other subjects. We were told that we must have a nose for news; that we must learn through doing; that there is a growing need for trained personnel and for teamwork in the health department from the clerk up to the health officer. All this and much more was given us to set us thinking and planning along lines that would lead us to do more effective jobs in the field of health education.

The only critical comments heard as to the Institute were that it was getting too large. Perhaps its guiding lights should remember the dinosaur, which grew too big to survive. We also feel that perhaps an attempt is made to cover too many topics in the program. Why not an Institute devoted to two or three pertinent and timely subjects? Such a limited program would permit the selected topics to be explored and studied from all angles with a greater degree of thoroughness. When such a variety of subjects is covered, as in the case of the last Institute, one is likely to become a bit confused—just as one is confused when trying to watch the whole of a three-ring circus at one and the same time. (In this connection we are reminded of the remark of Dr. Huntington Williams

who said: "There has been so much going on at this Institute from morning till night, that I have not even had time for a little applied personal hygiene.")

In summing up, we feel that the Institute greatly augmented our store of facts and information and opinions. We left it believing that we knew a lot more about various topics in which we were interested and with which it is our professional duty to deal. But the mere acquisition of facts and information was not the chief thing which the Institute gave us. Of more importance is the fact that it gave us a certain insight—an insight that will help us to meet more effectively the problems that confront us daily in our work. So with high hopes and appetites whetted by the 1940 session, and with congratulations particularly to Dr. Hiscock, we look forward with many, many others (too many?) to attending the 8th Annual Health Education Institute next year in Atlantic City.

MAGAZINE ARTICLES

Current popular magazine articles on health or of medical import:

"New Miracles in Healing." Constance J. Foster in collaboration with Russell L. Cecil, M.D. *Parents Magazine*. November, 1940.

"The New Starvation." George W. Gray. *Harper's Magazine*. October, 1940.

"Overweight." George W. Gray. *Harper's Magazine*. September, 1940.

"Long Life to You." Gretta Palmer. *McCall's Magazine*. December, 1940.

"They Can Come Back." C. R. Walker. *McCall's Magazine*. December, 1940.

"Trouble With Your Feet." Maxine Davis. *Good Housekeeping*. November, 1940.

"Exploring a New World." Watson Davis. *Reader's Digest*. November, 1940.

"Cutting the Doctor's Bill to Fit." F. De Armond. *Nation's Business*. November, 1940.

"They're Still Freezing It." *Printer's Ink Monthly*. September, 1940.

(The above is not presented as a complete list and the articles cited are not necessarily recommended.)

ANTIVENEREAL PUBLICITY

The wealth of health education material emanating from the Division of Venereal Diseases of the U. S. Public Health Service has been of a high order. This statement applies to the literature, posters, exhibits, films, and educational circulars that the agency has turned out in such steady succession. When the campaign against syphilis finally reaches its goal, Dr. R. A. Vonderlehr, Howard Ennes, and their cohorts in the Division of Venereal Diseases can rest assured that the concentrated attack which they have made on this problem through the division's varied publicity media will go down as a contribution of first rank.

We especially like the posters which this agency is issuing in its "Poster-a-Month" series. Here we have proof that the great advertising agencies have no monopoly on talent, as the syphilis posters have, for the most part, been as effective, attractive, and attention-arresting as any that are produced by commercial agencies specializing in the production of such items. The poster entitled "Face the Facts about Syphilis" is an expert job on many counts. The design or layout has a certain rhythmic effect that is most pleasing to the eye,

color is effectively employed, the essential message is easy to read, and there is no confusion in the use of type. Here, then, is a poster that every health agency can display with pride. On the other hand, it may appear to many that the poster entitled "No Home Remedy or Quack Doctor Ever Cured Syphilis" falls short of the standard of excellence set by the other posters in the series. The design seems confusing to the eye, the numerous styles of type employed in the layout likewise tend to confuse the reader, and the essential message is almost completely lost as it is placed at the bottom of the poster where it is submerged by the color and detail of the surrounding layout. A more serious criticism that occurs to us is that this poster may possibly mislead some people who will read it hastily. The focal point of the poster contains this statement, "Dr. Welsh's G O N - M E D — recommended for use in the treatment of gonorrhea." Isn't it possible that this statement will be misconstrued by some casual readers as a recommendation for a so-called "sure cure"?

On the whole, however, we highly commend and recommend the useful publicity materials that the Division of Venereal Diseases is producing.

RADIO SPEAKERS—PLEASE NOTE

December is a month when health officials are frequently called upon to make radio addresses in connection with Community Chest drives, Christmas Seal campaigns, and other seasonal activities. A little pamphlet issued by the National Association of Broadcasters, in which pointers for radio speakers are set forth, is therefore worthy of attention. If you are interested in developing a "radio personality" and in observing "radio etiquette," remember these pointers:

1. You *speak*—you don't shout.
2. The audience you have depends upon what you say in the first 2 minutes of your talk.
3. Tie up your introduction with something timely, well known or unusually pertinent.
4. Few speakers can hold radio attention for more than 15 minutes.
5. Write short sentences. Use picture words. Try it on a friend. Remember, you have radio competition.
6. Be friendly. Be sincere.
7. *Do not cough or sneeze into the microphone.*

Just in case you may consider yourself an experienced radio speaker who needs no further advice on the subject, we drop this gentle hint—the National Association of Broadcasters sent a copy of their little booklet to Franklin D. Roosevelt!

SCIENCE THROUGH THE CAMERA'S EYE

Watson Davis's new book entitled *Science Picture Parade* is worthy of a most laudatory review, despite our hesitancy to recommend it. We confess that this hesitancy on our part springs from pure, unadulterated jealousy. Several years ago we conceived the idea of a book embodying a collection of photographs dealing with scientific progress and to this end we had accumulated a file of pictures. Moreover, we had planned to arrange the pictures and accompanying text along lines almost identical with those followed by Mr. Davis. But the gestation period of our book was too long—thus permitting Mr. Davis to deliver his book before ours saw the light of day. There is consolation for us, however, in the realization that Mr. Davis has done a superb job, and we congratulate the author on his attractive, informative, and well written book.

Science Picture Parade covers many important fields of man's endeavor in which science plays a stellar rôle. Chemistry, radio, meteorology, electricity, archeology, and health are among the subjects discussed and pictured. The section on health is especially well presented. This section touches upon

chemotherapy, cancer, mental disease, vitamins, hormones, and other pertinent topics. Among the dramatic photographs found in the health section are the celebrated shot of a sneeze, the arresting photo of a recent smallpox case in New York State, and a microphotograph of the crystals of vitamin B_1.

In Mr. Davis's book one finds the mighty story of science told as effectively by means of the lens as it has been told before by means of the pen. *Science Picture Parade* deserves a place on the shelf of every health education library.—*Science Picture Parade*, by Watson Davis. 327 pages. Published by Duell, Sloan and Pearce, Inc., 270 Madison Avenue, New York, N. Y.

BOOKS RECEIVED

IT IS YOUR LIFE. Keep Healthy—Stay Young—Live Long. By M. M. Rosenberg. New York: The Scholastic Book Press, 1940. 450 pp. Price, $2.50.

THE CONTROL OF TUBERCULOSIS IN THE UNITED STATES. By Philip P. Jacobs. Rev. Ed. New York: National Tuberculosis Association, 1940. 387 pp. Price, $2.00.

BE SAFE AND HAPPY. By Sallie Stribling and Antoinette Williams. New York: Heath, 1940. 96 pp. Price. $ .32.

THE NEUROSES IN WAR. Emanuel Miller, Editor. New York: Macmillan, 1940. 250 pp. Price, $2.50.

BACILLARY & RICKETTSIAL INFECTIONS. Acute and Chronic. By William H. Holmes. New York: Macmillan, 1940. 676 pp. Price, $6.00.

INTRODUCTION TO PARASITOLOGY, WITH SPECIAL REFERENCE TO THE PARASITE OF MAN. By Asa C. Chandler. 6th ed. New York: Wiley, 1940. 698 pp. Price, $5.00.

PENNY MARSH FINDS ADVENTURE IN PUBLIC HEALTH NURSING. By Dorothy Deming. New York: Dodd, Mead, 1940. 236 pp. Price, $2.00.

FACTORS AFFECTING THE COST OF REFUSE COLLECTION. Bulletin No. 10. 31 pp.

REFUSE COLLECTION METHODS. Bulletin No. 11. 55 pp.

REFUSE COLLECTION EQUIPMENT. Bulletin No. 12. 58 pp.

Chicago: American Public Works Association, 1940. Each $ .50.

SEX IN DEVELOPMENT. By Carney Landis, et al. New York: Hoeber, 1940. 329 pp. Price, $3.75.

SYPHILIS BY CENSUS TRACTS. March, 1939. Prepared by Howard Whipple Green. Cleveland: Cleveland Health Council, 1940. 20 pp.

TEACHING HEALTH AND SAFETY IN ELEMENTARY GRADES. By Willard Walter Patty. New York: Prentice-Hall, 1940. 271 pp. Price, $2.50.

EMOTION AND CONDUCT IN ADOLESCENCE. By Caroline B. Zachry. New York: Appleton-Century, 1940. 563 pp. Price, $3.00.

TABER'S CYCLOPEDIC MEDICAL DICTIONARY. By Clarence Wilbur Taber. Philadelphia: Davis, 1940. Price, $2.50; thumb ind., $3.00.

CONTROLLED FERTILITY. An Evaluation of Clinic Service. By Regine K. Stix and Frank W. Notestein. Baltimore: Williams & Wilkins, 1940. 201 pp. Price, $3.00.

EMOTIONAL HYGIENE. The Art of Understanding. By Camilla M. Anderson. 2d ed. Philadelphia: Lippincott, 1940. 253 pp. Price, $2.00.

A SURGEON'S LIFE. The Autobiography of J. M. T. Finney. New York: Putnam, 1940. 396 pp. Price, $3.50.

INTRODUCTION TO SOCIAL CASE WORK. By Josephine Strode. New York: Harper, 1940. 219 pp. Price, $2.50.

A GUIDE TO HUMAN PARASITOLOGY. By D. B. Blacklock and T. Southwell. 4th ed. Baltimore: Williams & Wilkins, 1940. 259 pp. Price, $4.00.

VITAMINS. What They Are and How They Can Benefit You. By Henry Borsook. New York: Viking Press, 1940. 193 pp. Price, $2.00.

PRINCIPLES AND PRACTICE OF BACTERIOLOGY. By Major Arthur H. Bryan and Charles G. Bryan. Revised and enlarged. New York: Barnes & Noble, 1940. 410 pp. Paper edition, $1.25.

BOOKS AND REPORTS

Carlos Finlay and Yellow Fever—*By Carlos E. Finlay, M.D. New York: Oxford University Press,* 1940. 249 pp. Price, $4.00.

The chief object of this book is to tell the story of a man who as the result of keen observation, persistent study, experimentation, and careful reasoning conceived the idea that yellow fever, that great plague of tropical countries, was transmitted from man to man through the agency of a mosquito, and who in spite of all discouragement, lack of recognition, and even ridicule, persisted in calling attention to the epidemiological evidence he had collected and to urge destruction of the mosquito to control the disease. Even after his theories were brilliantly proved by the American Commission, headed by Walter Reed, and accepted throughout the world, recognition of the value of Dr. Finlay's work has not been generally adequate.

In 1881 he announced the theory of the transmission of yellow fever by the *Culex,* latter known as the *Stegomyia fasciata,* and now as the *Aëdes aegypti.* Gorgas, in his *Sanitation of Panama,* calls attention to Finlay's acumen in picking out this mosquito from among the five or six hundred varieties in Cuba as the one responsible for carrying yellow fever. Dr. John W. Ross, Medical Director, U. S. Navy, said in 1905, the selection of the *Stegomyia fasciata* " was a work of true genius."

The American Commission, appointed by Surgeon General Sternberg in 1900, consulted Finlay, and he furnished the eggs from which were reared the mosquitoes used by the Commission in the brilliant experiments which settled the matter once and for all, yet in spite of this confirmation of the theories which Finlay had persisted in putting before the public for some 20 years, general recognition of the part he played in unraveling the etiology of yellow fever has not been granted. Finlay was the first to suggest and to carry into practice the use of mosquitoes which had bitten a yellow fever patient within the first 5 days of the disease and then causing them to bite a non-immune, the date being June 30, 1881. He believed that he had been successful in producing yellow fever, but this has been disputed by authorities, such as Carter and the American Commission on technical grounds.

Finlay was attached to the first American Yellow Fever Commission (1879) by the Spanish Governor-General. To their findings, and especially to photomicrographs of blood made from preparations by Sternberg, he ascribed his abandonment of the telluric origin of yellow fever, and led him to the theory of a blood-sucking insect. This was 13 years before Manson put forward his theory concerning the malarial parasite (1894–1896), and 14 years before the conclusive work of Ronald Ross (1895–1897). In 1878 Manson demonstrated the rôle of the mosquito in the transmission of filariae.

The book is a labor of love by a devoted son, who was prompted to write it by Dr. Morton C. Kahn who, in 1936, had the opportunity to look over Finlay's records. He felt that as the material was almost all in Spanish, too little was known in the English-speaking world of the work of Carlos Finlay and his important contributions.

A little more than half of the volume is given to Carlos Finlay and his work, beginning with his family history. The rest considers yellow fever, its distribution, and its influence on the world up to the present, including the discovery of jungle yellow fever. There is a long historical chapter on Origin of Yellow Fever, and the text ends with a Summary of 6 pages. There are 3 Appendices, giving extracts of letters, opinions, and testimonials, a list of papers on yellow fever by Finlay, and a second on other medical and scientific subjects, which shows the wide range of his scientific interests.

The printing and make-up are good. There are a number of interesting photographs, and one plate in color, showing the Medallion and Rosettes given to Finlay by the Cuban Government.

We are glad to note from the Preface that an English translation of the papers by Finlay is being prepared. This has already been too long delayed. The book by his son will be welcomed by all who are interested in medical history and the epidemiology of yellow fever. As well stated in the Foreword: "When one considers the hundreds of years of darkness that preceded this observation, the thousands of victims who perished because no means of control was known, the work of this brilliant, modest Cuban investigator must stand out as one of the world's most important contributions." MAZŸCK P. RAVENEL

Nursing as a Profession—*By Esther Lucile Brown. (2nd ed.) New York: Russell Sage Foundation,* 1940. 152 pp. Price, $.75.

The Russell Sage Foundation has published monographs on certain established or emerging professions including those on social work, law, engineering. This volume is the one on nursing. It represents careful research done in gathering and interpreting data obtained from interviews, questionnaires, books, periodicals, and unpublished studies.

The latest conclusions as to the comparative value and cost of graduate and student nurse service in a hospital; the functions and accomplishments of the four most important national organizations that are interested in standards of nursing and nursing education; the problems of distribution of professional nursing services in various sections of this country; the reasons why large groups of the population do not employ professional nursing services—all these are intensely interesting and vital for one who needs to see the whole scope of nursing today.

Many of the developments and trends in professional nursing are encouraging and show that it is fast taking its place beside the older or more established professions.

This compact, well printed volume is decidedly important, valuable and significant. EVA F. MACDOUGALL

Poisons: Their Isolation and Identification—*By Frank Bamford. Philadelphia: Blakiston,* 1940. 344 pp., 21 ill. Price, $4.00.

As pointed out in the preface, the purpose of this book is to provide a serviceable laboratory manual for the chemist working in toxicological analysis. It is a "practical handbook" rather than a comprehensive treatise on the subject. A knowledge of the chemistry involved in the various tests is assumed, and the discussions of this aspect of the work is meager. Biological effects of poisonous substances, as well as post-mortem signs, are generally well discussed. For a book of this size, there is a surprisingly large number of poisons discussed. This has been accomplished in part by limiting the tests described in detail to those of greatest significance, with others mentioned only by reference. Also a considerable amount of material on alkaloids is con-

densed by presentation in tabular form.

The introduction, devoted to the organization and equipment of a toxicological laboratory, is well done, particularly the discussion of the handling and storage of material for analysis. The part devoted to apparatus might well have included a discussion of various types of extraction apparatus. The material on metallic poisons and on alkaloids is extensive and given in considerable detail. There is some description of the sources of alkaloids with a summary of the physiological effects and the color reaction given in tabular form. Most of Chapter IX is given over to a detailed discussion of the Stas-Otto Process for the isolation of non-volatile organic poisons.

The chapter on Non-Basic Organic Poisons includes brief sections on phenolic poisons, barbiturates, salicylic acid and its derivatives, glycosides, saponins and purgative drugs.

Chapter headings are as follows: Introduction, Classification of Poisons, Volatile Poisons, Metallic Poisons, Corrosive Acids and Alkalis, Non-Volatile Organic Poisons (Alkaloids), Non-Basic Organic Poisons, Isolation of Non-Volatile Poisons, Systematic Scheme for the Identification of Alkaloids, Systematic Testing for Non-Basic Poisons, Miscellaneous Poisons, Drugs of Addiction.

The book can be recommended for the chemist who has had some experience in toxicological analysis and who wants a concise description of the more important features in that field.

H. E. FRENCH

Social Work Engineering: An Outline of Topics for Survey, Planning and Appraisal—*By June Purcell Guild and Arthur Alden Guild. New York: Harper,* 1940. 136 pp. Price, $1.75.

This is an expanded revision of the manual for social workers, *Handbook on Social Work Engineering,* privately published in 1936. Based on practical experience, consideration is given to the integration of private social effort with government spending, the adjustment of programs to meet changing community needs, the development of programs for dealing with dependency, delinquency, health, informal education and recreation, and methods of raising money. The usefulness of the earlier volume promises much for the utilization of this book by those engaged in constructive community planning.

IRA V. HISCOCK

The Troubled Mind: A Study of Nervous and Mental Illnesses—*By C. S. Bluemel, M.D. Baltimore: Williams & Wilkins,* 1938. 520 pp. Price, $3.50.

A Handbook of Elementary Psychobiology and Psychiatry—*By Edward G. Billings, M.D. New York: Macmillan,* 1939. 271 pp. Price, $2.00.

We have here two psychiatric texts as different from each other as a thermometer from a scalpel but serving well their respective purposes—one a popular exposition of the nature and causes of mental and nervous disorders, the other a psychiatric manual for the instruction and guidance of the physician in the understanding and management of these disorders.

Dr. Bluemel offers the general reader a broad orientation to the whole vast field of mental morbidity, in its many aspects and ramifications, beginning with the phenomena of fixed ideas in the normal mind and their more abnormal manifestations in the various phobias, and running through the catalogue of the psychoneuroses, with their numerous physical concomitants, the traumatic hysterias and hysterical paralyses, such miscellaneous disorders as migraine, stammering, alcoholism and drug addiction, with their emotional

components, and the outright psychoses in their standard classifications.

The presentation is on a purely descriptive and symptomatic level, a sort of topography of the land of unreason, profusely illustrated with case histories and elaborated in its recital of clinical details almost to the point of tedium. A saving feature of the book is its simple conversational style, but a little less prolixity and a drastic pruning of the case material to one half its present contents, would have improved considerably its readability.

In spite of its limitations, *The Troubled Mind* is a worth while addition to the as yet meager supply of non-technical books that are needed to enlighten the public with regard to the meaning and significance of one of the major problems of medicine and public health. It is a wholesome treatment of a morbid subject—refreshingly so in its avoidance of the "sexual excesses" of case citations characteristic of so many texts on psychopathology. The layman will learn a lot from this volume and its interesting interpretations of various types of mental maladjustment.

Of a very different sort is Dr. Billings's book, intended primarily for the general medical practitioner and the medical student, but of value also to the specialist in mental and nervous diseases. How valuable it should be to the general physician is obvious from the fact, now widely recognized, that emotional and personality disorders account for a large proportion—estimated at from one-third to one-half—of the clinical problems he is called upon to explain and treat in his everyday practice. Modern psychiatry has not only revolutionized our understanding of the mental disorders, but is also furnishing new and useful concepts of the meaning of disease in general, exemplified by what has become known as "psycho-somatic" medicine, based on a view of the human organism functioning as an integrated biological whole. Dr. Adolf Meyer's formulations, systematized in what he calls "psychobiology," the dominant discipline in American psychiatry today, have contributed largely to the development of this view.

Dr. Billings gives us a lucid and revealing interpretation of this discipline, with all its implications for the understanding of the complex factors of personality functioning in human maladjustments associated with physical as well as mental illnesses. It is a distillation of the principles of psychobiology and scientific psychiatry presented in a way conducive to their practical application as well as theoretical grasp by the average medical practitioner who turns away from the conventional psychiatric texts. It is the result of five years of clinical work and teaching at the Psychiatric Liaison Department of the Colorado General Hospital and the University of Colorado School of Medicine, and derives its peculiar excellence from the author's actual experience with physicians working in all the usual fields of medicine.

The book is divided into five parts. Part I defines psychobiology and explains clearly and compactly the integrated elements that enter into its conceptual and theoretical structure. It lays the foundations for the physician's and student's orientation to the psychiatry that follows. Part II is a guide to psychiatric examination procedures and clinical study. Part III is a discussion of general psychopathology in the light of psychobiological principles, in which the dynamics of normal and abnormal personality functioning in the minor and the major psychoses are interpreted. Part IV describes the general principles of psychotherapy and their special applications. Part V is a bibliography of selected references to the literature of psychiatry, recom-

mended to those who wish to pursue their studies further in this field.

This little volume is an expertly prepared compendium of hard-won knowledge made comparatively easy for the busy practitioner who appreciates the practical import of psychiatry for the more effective conduct of his practice, in whatever branch of medicine he follows. It is worth its weight in therapeutic gold. PAUL O. KOMORA

Industrial Microbiology—*By Samuel Cate Prescott and Cecil Gordon Dunn. New York: McGraw-Hill,* 1940. 541 pp. Price, $5.00.

In this important new book, these well known authors deal with the fundamentals of the utilization of yeasts, bacteria, and molds for the production of industrially important or potentially valuable products. The book considers the organisms, methods of their cultivation, conditions of fermentation, end-products, and biochemistry of the fermentations. Many recent advances in the fermentation industries and in research are discussed.

While for thousands of years mankind has practised domestic arts with the aid of microbes, it was less than a hundred years ago that there was any scientific appreciation of the real part microbes play in the transformations of organic matter, and the subject of industrial microbiology is one of the important outgrowths of fundamental researches conducted by Pasteur who may be regarded as its founder as well as of medical bacteriology and immunology. In 1896, the senior author organized at the Massachusetts Institute of Technology the first course of classroom instruction in industrial biology given in America.

Both the theoretical and practical aspects of fermentation are extensively considered. The work is adapted for fairly advanced students in biology, general bacteriology, and the fundamentals of organic chemistry and biochemistry. Despite its scope, the authors purposely omitted a number of features such as the commercial manufacture of sera, vaccines, and other therapeutic agents, and the culturing of certain organisms, as in butter and cream-ripening, nitrogen-fixation and others, as more intimately related to public health and medicine, or to agricultural and dairy industries.

Of particular interest to industrial hygienists are the multitude of poisonous substances generated by fermentation. These range all the way from aldehydes, acetones, and alcohols through arsenious emanations, esters, oils, fats and lipids, glycerols, pigments, and sulfur compounds to zinc—to mention only a few groups. In fact, the organic compounds in general have numerous sources in these microbic activities. Occasionally the dangers are implied. However, we note one countenanced procedure which should be accompanied with a definite warning, viz., silage tramped down by men in silos, in one of which we once had occasion to investigate four sudden deaths due to the inhalation of air showing marked O_2 deficiency and containing excessive quantities of CO_2 (*J.A.M.A.*, 53:1570–1572 [Oct. 31], 1914).

Some 40 pages are devoted to textile and wood microbiology. There is an Appendix on detergency, disinfection, and sterilization, and another on the treatment and disposal of industrial microbiological wastes. Bibliographical references, some extensive, follow each chapter (with author citations in the combined subject and author index—the last 35 pages of the text). There are also innumerable descriptive and structural formulae and tables, and many illustrations.

A comprehensive work in English such as the present one should be of special interest, not only to the technical groups concerned, but to laboratory workers in

general and physicians located in centers where these fermentation processes engage workers in industrial or commercial procedures.

EMERY R. HAYHURST

Progress in Medicine: A critical review of the last 100 years—*By Iago Galdston, M.D. New York: Knopf,* 1940. 347 pp. Price, $3.00.

Dr. Galdston enjoyed writing this book and it should be read for enjoyment. It tells the story of the last hundred years as seen through the eyes of a psychobiologist with a fondness for metaphysics. A physicist or a chemist would have told a different story, including perhaps the development of x-rays, the discovery of radium, or the contributions which blood chemistry have made to medicine. But such a one would not have devoted 46 pages to hypnotism nor could he have written the chapter on Freud; an essay of rare and sympathetic insight and one which everyone should read who has ever scoffed at the psychoanalysts.

The penultimate chapter, entitled "A Century of Clinical Progress," is devoted very largely to the thesis that clinical progress is unimportant. For one thing, it has made medicine too expensive. And again, if we cure a man of one disease, how do we know he will not soon after die of some other disease? It is much better to prevent his getting any disease. There is a great deal of truth as well as of originality in this chapter. It is true that the public health pioneers of 100 years ago were social reformers driven by a great humanitarian urge. It is true that public health workers today are largely employees of some corporate or official body. But some of the zeal of the pioneers may have been misplaced for all that. Their efforts at "garbage disposal and nuisance abatement" were not as a matter of fact so valuable as our cold-blooded epidemiology. And a man with early tuberculosis today will be more fortunate if he gets an x-ray of his chest than if he is moved into a larger house.

"It is argued" writes Dr. Galdston, "that more and better medical service would gain the people superior health, which, of course, is partially true." This grudging admission unless it is intended for meiosis, probably indicates that Dr. Galdston thinks of "medical service" as curative medicine only. It cannot be overlooked, however, that systems of group practice have made possible a large place for preventive medical service within the unofficial practice of medicine. Indeed the pediatricians have succeeded very well in introducing preventive medicine into the private competitive system. This, in the final chapter, Dr. Galdston recognizes though he rather spoils the effect by an artful but unprofitable effort to distinguish between the prevention of disease and the production of health.

J. ROSSLYN EARP

Report of Industrial Hygiene Sessions, 15th Annual Convention Minutes, Part II—*By the National Battery Manufacturers' Association. Akron, Ohio: Published by the Association,* 1940. 93 pp. Price, $2.00.

The convention was held at Chicago, October, 1939. Contents (and the number of pages devoted to each): Introductory remarks, by L. B. F. Raycroft, 2; Discussion of engineering problems in lead hazard, with tables and forms, by J. J. Bloomfield, 12; Report of survey of lead hazard in the storage battery industry, with tables, forms, illustration, references, and bibliography, by W. C. Dreessen, 15; Respirators and respiratory protections as applied to the lead battery industry, by William P. Yant, 10; Engineering phases of control of lead exposure in small battery plants, by Warren A. Cook, 3; Discussion of recent studies with summary of analytical results cor-

related with chemical data and suggested methods of plant control, with tables and references, by Robert A. Kehoe, presented by Willard Machle, 9; Experience with lead hazard in a group of storage battery plants, with one table, by W. J. McConnell, 2; Lead poisoning in small battery operations, by Carey P. McCord, 2; Adequate medical facilities for control of lead absorption, with two figures and bibliography, by Elston L. Belknap, 5; Case history in compensation claim for lead poisoning, by C. O. Sappington, 3; and Control of lead hazards, with one figure, by H. H. Valiquet, 3.

The last 14 pages are devoted to the 1939 annual convention minutes, comprised of questions, answers and remarks pertaining to the general subject matter, which discusses one of the most important industrial sources of lead poisoning of the present day.

EMERY R. HAYHURST

All the World To See! Twenty-fifth Annual Report—*The National Society for the Prevention of Blindness, Inc. (New York)*, 1939. 12 pp.

Well printed, effectively illustrated, and carefully written, this annual report outlines the collaboration with professional groups of wide diversity, having a common interest in the conservation of vision. Doctors, nurses, school teachers, social workers, safety engineers, government and private health agencies, and civic organizations throughout the United States are assisting in the movement for the protection of eyesight.

There are approximately 150,000 blind persons in the United States. "The tragedy in the lives of these individuals and their families is heightened by the fact that blindness is preventable in the majority of cases. . . . The underlying reason for loss of sight, whether it be the result of disease or accident, is usually ignorance."

In view of the fact that more than 16 per cent of the blind population lost their sight as a result of syphilis or gonorrhea, the Society takes an active interest in the problem of venereal disease control. There are 30 states which have premarital examination laws and 17 states which have provisions for compulsory blood tests for expectant mothers.

There are 602 sight-saving classes for the education of school children with seriously defective vision, 15 such classes having been added in 1939. The Society participated in the giving of special courses at five colleges for the training of sight-saving class teachers and supervisors. Research studies and health education are among the other services rendered during the year.

IRA V. HISCOCK

The Diagnosis and Treatment of Pulmonary Tuberculosis—*By John B. Hawes, 2nd, M.D., and Moses J. Stone, M.D. (2nd ed.) Philadelphia: Lea & Febiger*, 1940. 260 pp. Price, $2.75.

If the reader liked the first edition of this compact, concise volume which was published in 1936 he will be even more pleased with this second edition. To be sure, only 45 pages have been added, but the choice of new material and the revision of the old have been made discriminately.

There are two new chapters, one on immunity, resistance and allergy, and the other on the mental aspects of tuberculosis. These are valuable additions, especially in view of the increasing attention being paid in tuberculosis circles to endogenous v. exogenous infection and psycho-somatic influences in disease, respectively.

The sections that have undergone the greatest revision are those on "Roentgen-Ray Diagnosis in Pulmonary Tuberculosis" and "Collapse Therapy."

Although all but two of the chapters

contain lists of selected references for supplementary reading it is regrettable that suggestions for further reading and study have been omitted from the sections on "Specific Treatment of Pulmonary Tuberculosis by Serums, Vaccines and Drugs," and "Mental Aspects of Tuberculosis," on both of which there is interesting material in the literature. Also, the list of references following the chapter on rehabilitation could have been greatly improved by adding publications of more recent vintage, and should have included material on recent coöperative efforts on the part of federal and state bureaus of rehabilitation, tuberculosis sanatoria, and tuberculosis associations, which are pooling their interests to break into the circle of continuity of care for the patient from the time the patient is discovered as being tuberculous until his return to gainful employment.

The publishers maintain in this volume their standard of excellence in the reproduction of the fine diagrams, charts, and x-ray photographs, which were characteristic of the earlier edition.

This publication is recommended as a handbook for ready reference to general practitioners, medical students, nurses, social workers, and health administrators.

BERNARD S. COLEMAN

Text-Book of Public Health—*By W. M. Frazer, M.D., and C. O. Stallybrass, M.D. (formerly by Hope and Stallybrass). (10th ed.) Baltimore: Williams & Wilkins,* 1940. 504 pp. Price, $6.50.

A book which has gone through 10 editions needs little more than an announcement of a revision. The present edition has been considerably enlarged. The Preface gives us a history of this book, which began its life in 1874 in a small way as an addendum to Husband's *Text-book of Forensic Medicine.* Succeeding editions have appeared under several authors and titles, but it was not until the 8th that it assumed its present title under the authorship of Professor Hope. This 10th edition is the first under the present authorship.

The book gives a thorough review of the subject to which it is devoted, almost too concise, however, in some respects. Its chief use for us in America will be as a reference, since, like all English books on public health, it is based on the laws of that country which cover an enormous volume of material, but has fortunately been consolidated to a great extent in the Public Health Act, 1936, the Housing Act, 1936, and the Food and Drugs Act, 1938. Full accounts of these Acts are given in the present text.

The mental attitude of the English at present as well as their necessities is indicated by a chapter on The Medical Aspects of Civil Air Defense. This describes first aid, ambulance service, hospitals, types of bombs, and war gases, with such measures as are possible for the prevention of their evil effects.

The printing and make-up are excellent and the book can be thoroughly recommended for the purposes for which it is intended. There are many well chosen illustrations and charts, and a good index closes the volume.

MAZŸCK P. RAVENEL

A SELECTED PUBLIC HEALTH BIBLIOGRAPHY WITH ANNOTATIONS

RAYMOND S. PATTERSON, PH.D.

First on Your Reading List—Among the young men who will be rejected for the draft there will be 140,000 with tuberculosis, 300,000 with syphilis, many more with other communicable diseases or physical defects. What's to be done for them, and for a dozen related health problems concerned with national defense is discussed in this important state paper.

ANON. Public Health in the National Defense Program. Pub. Health Rep. 55, 39:1760 (Sept. 27), 1940.

Some Very Vital Statistics—Provisional figures of the 1940 Census indicate a rate of increase during the last decade less than half any previous decade since the first census in 1790. In no previous decade have more than 3 states declined in population. Now there are 6. City growth rates, too, showed a sharp decline.

ANON. Preliminary 1940 Population Figures for the United States by States. Pub. Health Rep. 55, 42:1879 (Oct. 18), 1940.

Pregnancy Is Not Pathological—You would suppose the British sanitarians would be so preoccupied with air raid casualties that they would have little thought for ordinary matters, but in this editorial you will find the germ of an idea that may have some application on this more tranquil side of the water. It is this: though the case for antenatal supervision is strong, is there not danger that our prevention-of-excessive-maternal-mortality approach to prenatal hygiene may influence the expectant mother's attitude, causing her to think of her pregnancy as pathological rather than a perfectly natural physiologic condition? Pelvic measurements, frequent specimen analyses, and excessive goings-over may create groundless fear rather than reassurance.

ANON. The Psychology of Pregnancy. Med. Off. 40, 4:38 (July), 1940.

Health of the Worker—Industrial hygiene has much to contribute to national defense by conserving and developing skilled workers, preventing lost time, and increasing efficiency. Some of the things that remain to be done if this desirable goal is to be achieved are discussed in wholesome detail in this paper read at the Detroit meeting.

BRISTOL, L. D. Industrial Health and National Defense. J.A.M.A. 115, 15:1236 (Oct. 12), 1940.

Health Museums Urged—Careful surveys of consumer reactions lead to the belief that the World's Fair Hall of Man was a useful and effective means of large scale health education. Hence it is proposed that museums situated throughout the country be created to do for all what was done for the 7,500,000 who visited the Medicine and Public Health Building.

CALVER, H. C. Health Information, Please. J.A.M.A. 115, 15:1251 (Oct. 12), 1940.

More about Our National Evolution—Convincing reasons why social insurance is the soundest method of providing security in old age make notable this first of three final papers of the Round Table on Population Problems. The other two, on the effect of population trends on public health and social welfare are also not to be missed. You may remember that the first three papers were mentioned in the September bibliography (q. v.).

CLAGUE, E. The Aging Population and Programs of Security (and two related papers). Milbank Quart. 18, 4:345 (Oct.), 1940.

Lay Help in Telling the World—Citizen committees to disseminate information about official public health programs are discussed. The staff must be convinced that laymen can help; there must be a careful and intelligent selection of members; there must be a formal organization; and the committee must be given freedom of effort, this writer suggests.

DAVIS, E. K. Citizen Committees in Official Agencies. Pub. Health Nurs. 32, 10:588 (Oct.), 1940.

Food for Smokers' Thoughts—It is probable that smoking has an effect on younger people, influencing perhaps the earlier development of coronary disease. In old people the arterial changes go on regardless of the possible harm of tobacco smoke. A greater incidence of coronary disease among people under 50 was found in smokers than among non-smokers, and it was greatest among the heavy smokers.

ENGLISH, J. P., *et al.* Tobacco and Coronary Disease. J.A.M.A. 115, 16:1327 (Oct. 19), 1940.

Cleanliness through the Ages—About 2,000 years B.C., the Minoans made bath tubs remarkably like our own and perhaps more artistically decorated. There are many more historical facts about sanitary practices in this brief paper which is commended to all who have any curiosity whatever about the sources of our *own* sanitary mores.

GRAY, H. F. Sewerage in Ancient and Medieval Times. Sewage Works J. 12, 5:939 (Sept.), 1940.

When Air Sirens Wail—Among the health administrative jobs following air raids are the training of personnel for decontamination work and to determine the suitability for habitation of the damaged dwellings. First aid for casualties is part of the British H. O.'s job. It's devoutly to be hoped that American sanitarians will never have more than an academic interest in these problems.

HAY, C. P. The Public Health Department and Air Raid Precautions. Med. Off. 40, 4:41 (July 23), 1940.

Revival of a Hardy Perennial—Venereal disease health education should include explicit directions about chemical and mechanical prophylaxis. Civilian as well as military authorities should provide preventive facilities. Research should be continued. These are the conclusions of a distinguished committee.

HAZEN, H. H., *et al.* The Chemical and Mechanical Prevention of Syphilis and Gonorrhea. J.A.M.A. 115, 14:1185 (Oct. 5), 1940.

Plain Talk about Tonsils—About one child in five has tonsils so grossly hypertrophied or chronically diseased that they adversely affect his well-being and, of course, should be removed. On the other hand, there is little or no evidence that colds, laryngitis, otitis media, bronchitis, pneumonia, or tuberculosis is reduced among tonsillectomized children. Tonsils are not often responsible for pulmonary infections. Hence the conclusion that tonsils are not the menace to the child's health that has been so frequently suggested. The moral need not be labored here.

KAISER, A. D. Significance of the Tonsils in the Development of the Child. J.A.M.A. 115, 14:1152 (Oct. 5), 1940.

A Grain of Salt—In this controlled demonstration it was found that the eating of gelatin had no effect upon the ability of human muscles to perform work. As the usual dietary of protein is quite adequate, there is no reason to assume that more in the form of gelatin will do any good despite what you read in the back of the best magazines.

MAISON, G. L. Failure of Gelatin or

Aminoacetic Acid to Increase the Work Ability. J.A.M.A. 115, 17:1439 (Oct. 26), 1940.

From Thoreau to Thoracoplasty—Briefly surveyed is the whole history of the progress of the tuberculosis control movement as an introduction to an excellent statement of the present-day medical responsibilities in case finding, treatment, and rehabilitation.

MILLER, J. A. The Drama of Tuberculosis. J.A.M.A. 115, 15:1272 (Oct. 12), 1940.

Vitamins A to D—Included in this discussion of the food sources of the most important vitamins are a new and useful list of the vitamin values of the common foodstuffs and a table of suggested daily requirements for vitamin A, thiamin chloride, riboflavin, ascorbic acid, and vitamin D.

MUNSELL, H. E. Vitamins and Their Occurrence in Foods. Milbank Quart. 18, 4:311 (Oct.), 1940.

For Proud Spirits—Tuberculosis, as a disease entity, is young when it first encounters a new population, it matures when it becomes fairly universal and grows senescent when the population becomes sufficiently resistant to cause a drop in the death rate. The dying out of the most susceptible families is one factor in this end. This thesis is a wholesome one for the complacent health worker to ponder upon when he is inclined to assume too much credit for the declining tuberculosis death rate.

PINNER, M. Epidemiological Trends of Tuberculosis. Am. Rev. Tuberc. 42, 3:382 (Sept.), 1940.

An Occupational Disease—Semi-annual chest x-rays of student nurses, annual examinations for graduate nurses, and testing of all patients on admission would answer the serious problem of tuberculosis among nurses. In Bellevue it appears that primary infection is no more frequent in nurses on the tuberculosis wards than among those on the other services. Here is discussion that comes close home to many public health administrators.

RIGGINS, H. MCL., and AMBERSON, J. B., JR. The Detection and Control of Tuberculosis Among Nurses. Am. J. Nurs. 40, 10:1137 (Oct.), 1940.

Timely Articles about Respiratory Diseases—Four exceedingly able papers deal, in turn, with the common cold, sinusitis as it affects other respiratory infections, the relationships of primary and reinfective types of tuberculosis, and the highly successful drug treatment of pneumonia. All four papers are brief but inclusive and are a decided "must" on your reading list.

SMILLIE, W. G., *et al.* Symposium on Infections of the Respiratory Tract. New Eng. J. Med. 223, 17:651 (Oct. 24), 1940.

Why Children Fail to Grow—Children in some of the lower school grades who had failed to gain weight for three successive months were studied to determine the probable contributing cause. Recent illness was found in 70 per cent; 8 per cent got insufficient sleep and 67 per cent insufficient calories. "Normal" weight children are as likely to show intermittency in growth as are under- or over-weights.

TURNER, C. E., *et al.* A Study of the Health of Children Showing Intermittency in Growth. J. School Health, 10, 8:228 (Oct.), 1940.

Syphilitics under Treatment—Some statistics to ponder over: with a persistent attack rate of 2 per 1,000, at least one adult in ten will acquire syphilis at some time; half the existing syphilis infections were acquired before age 25 and most of these in the teens. These are only two of the many significant findings of a Washington, D. C., study.

USILTON, L. J., and RUHLAND, G. C. Survey of Venereal Diseases in the District of Columbia. Ven. Dis. Inform. 21, 8:244 (Aug.), 1940.

ASSOCIATION NEWS

APPLICANTS FOR MEMBERSHIP

The following individuals have applied for membership in the Association. They have requested affiliation with the sections indicated.

Health Officers Section

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Frank J. Houghton, D.D.S., Jersey City Medical Center, Jersey City, N. J., Director of Dental Clinics

DECEASED MEMBER

Prof. Robert E. Chaddock, Ph.D., New York, N Y., Elected Member 1915, Elected Fellow 1922

The Sedgwick Memorial Medal

AT the Detroit Annual Meeting, the presentation of the Sedgwick Memorial Medal was made by Milton J. Rosenau, M.D., whose citation was as follows:

"The Sedgwick Memorial Medal this year is conferred on Dr. Hans Zinsser. The satisfaction one usually has in conferring an honor to a colleague is marred this time by the fact that it must be conferred posthumously.

Hans Zinsser, M.D.

"Dr. Hans Zinsser was a gem with many facets. He was an inspiring teacher, a notable scientist, a forward leader, a distinguished author, an active patriot, a free liberal, a wide traveler, a colorful personality, a royal sportsman, a sensitive poet and a brave soul.

"A sonnet he wrote when he knew his days were numbered has the calm, joyful attitude of the happy warrior. He wrote:

"'Now is death merciful. He calls me hence
Gently, with friendly soothing of my fears
Of ugly age and feeble impotence
And cruel disintegration of slow years.
Nor does he leap upon me unaware
Like some wild beast that hungers for its prey,
But gives me kindly warning to prepare:
Before I go, to kiss your tears away.
How sweet the summer! And the autumn shone
Late warmth within our hearts as in the sky,
Ripening rich harvest that our love had sown.
How good that 'ere the winter comes, I die!
Then, ageless, in your heart I'll come to rest
Serene and proud, as when you loved me best.'"

In accepting the medal from Dr. Rosenau, Dr. Haven Emerson made the following acknowledgment:

"On behalf of Hans Zinsser's wife and children, it is my very precious privilege to receive this enduring token of the admiration and affection of the multitude of humble workers in preventive medicine for whom his life was an inspiration.

"In his enchanting spirit of fellowship he wrote but a few months ago of his happiness in planning to attend this meeting to receive the Sedgwick Memorial Medal in person.

"No man ever left behind him from the very midst of high endeavor for his fellow man, so vivid a sense of his continuing presence among us."

EMPLOYMENT SERVICE

The Association Employment Service seeks to bring to the attention of appointing officers the names of qualified public health personnel and to act as a clearinghouse on employment. This is a service of the Association conducted without expense to employer or employee.

From the registry of persons available, selected announcements are published from time to time. Appointing officers may obtain lists of all registrants on request.

Positions Available

Assistant Epidemiologist—Qualified to give special attention to medical aspects of industrial hygiene, epidemiologic investigation and preventable disease; midwestern state department of health; salary $3,600 plus travel allowance. **W470**

Dental Hygienist—on field staff of eastern state health bureau; salary $1,500 per annum plus travel allowance; must be graduate of reputable dental hygiene school and have training in education and public health. **W471**

Positions Wanted

ADMINISTRATIVE

Experienced physician, graduate University of Illinois; M.P.H., Johns Hopkins, 1940; seeks administrative opening suitable to his proven ability. Excellent references. **A466**

Physician, 33; M.D., 1936; postgraduate course in venereal disease control, experienced as district health officer and in organizing and publicizing syphilis control campaign; now employed in charge venereal disease clinics in metropolitan health department; seeks venereal disease control post with opportunity to organize or administer program. **A437**

A position in epidemiology or administrative public health is desired by physician with C.P.H. from Johns Hopkins, 11 years' administrative public health experience, and excellent background of communicable disease control and school health service. **A368**

Physician, aged 43, interested in public health career, seeks full-time position as city or county health officer or school physician; 4 years' experience in New York State. P.O. Box 695, Kingston, N. Y.

Physician, M.D., Yale; M.S.P.H., Columbia; also short course for health officers, Vanderbilt; good clinical background; 3 years' public health experience; will consider appointment in child health, epidemiology or public health administration. **A350**

Physician, M.D., University of Cincinnati; with postgraduate training in venereal disease control, Johns Hopkins; is available as venereal disease control officer. **A363**

Physician, M.P.H., Harvard; well experienced in city and rural health administration, will consider appointment as district health officer or in city or state health department. **A418**

Woman physician, M.D., Cornell; M.P.H., Harvard; experienced in pediatrics; seeks administrative position. **A467**

Woman physician, graduate of University of Iowa, experienced as director of state bureau of maternal and child health, as well as health service director, seeks teaching position. **A318**

HEALTH EDUCATION

Well qualified woman physician, M.A. and M.D. from Stanford, with 6 years' experience in nationally known secondary school in health education and medical advisory duties, wishes position in college health work. **H448**

Young woman with splendid educational background, graduate of Massachusetts Institute of Technology health education courses; M.A., Columbia University, seeks position in health education or nutrition. **H462**

LABORATORY

Physician, C.P.H., Harvard-Technology; experienced as bacteriologist and pathologist and director of state laboratories; desires position. **L208**

Teaching, executive or administrative position desired by experienced teacher in bacteriology and public health; Ph.D., Cornell; now professor in grade A medical school. **L327**

Experienced woman bacteriologist, Ph. D., University of Illinois, 1937, wishes position in teaching or research. Excellent bibliography and references. **L410**

Experienced bacteriologist, young man of 33, Sc.B., who for several years has been in charge of state laboratory doing public health and diagnostic bacteriology, immunology and serology, will consider opening. **L427**

Bacteriologist, serologist, B.S., M.A. degrees; 2 years' experience foods, dairy and biochemistry in public health laboratory, desires position in research or routine. **L454**

MISCELLANEOUS

Industrial hygiene chemist, experienced in sampling, analysis of toxic industrial gases and fumes; petrographic dust analysis; dust counting; general toxicological analysis; chemical microscopy; also experienced in making industrial hygiene surveys; with knowledge of German, French, and Spanish; 4 years' experience; desires position. **I457**

Woman physician, with excellent medical training, experienced in maternal and child health and in generalized public health work, seeks position. **C376**

Advertisement

Opportunities Available

COUNTY HEALTH PHYSICIANS—(a) Young physician willing to locate in rural south; county now has four physicians to serve population of over 12,000; $3,500 annually for services to specific group; privilege of building outside practice. (b) Assistant county physician; recent graduate, unmarried, preferred; $125, maintenance, increasing to $150; California. (c) County health physician; experience must have included one year's experience general practice, one year's full-time experience in general public health work; training must have included minimum two quarters in approved school of public health; vicinity $4,200; East. (d) Several vacancies in South; training available for men interested in but lacking formal public health background; initial salaries around $3,000 plus travel allowance. PH 12-1, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

CITY HEALTH PHYSICIANS — (a) Virgin Islands; young married physician required; $2,400. (b) City of 10,000; will be in charge newly organized department consisting of full-time nurse, full-time sanitary officer, both directly under supervision of city physician; some public health training advantageous. $3,000, increasing; East. PH 12-2, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

YOUNG PHYSICIAN—Qualified to serve as chief of syphilis unit in municipal social hygiene clinic; minimum two years' experience in syphilis work required, preferably with teaching experience included; about $3,600, subject to increase. PH 12-3, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

ASSOCIATE DIRECTOR, SCHOOL OF PUBLIC HEALTH — Young physician with public health teaching experience to serve as associate director in school of public health, approved university medical school; Master's or Doctor's degree in Public Health required; $4,000, increasing. PH 12-4, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

PUBLIC HEALTH PHYSICIAN—For staff appointment in university school of public health; young man with degree in public health and successful experience in county health administration required; advantageous if interested particularly in epidemiology; salary open to discussion. PH 12-5, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

STUDENT HEALTH RESIDENCIES—Several to replace residents called for active service in National Defense Program; $1,200, maintenance; large university. PH 12-6, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

STUDENT HEALTH PHYSICIAN — Two-year fellowship available in eastern university; program will include teaching, some resident duties, clinical and research activities; first year, $1,500, maintenance; second year, $1,725, maintenance or $2,250 without maintenance; duties will begin immediately. PH 12-7, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

PUBLIC HEALTH NURSE EXECUTIVES—(a) Certified public health nurse with minimum Bachelor's degree to serve as consultant and educational director in state department of health; particular concern will be department of maternal and child health; $200 plus travel allowance. (b) Graduate nurse with B.S., C.P.H. and preferably M.S. degrees for public health instructorship, university school of nursing; theoretical preparation must have been supplemented by several years of public health nursing experience; salary adequate to secure services of best qualified applicant. (c) Public health nurse with some social service training for interesting staff appointment; large children's hospital. (d) Public health nurse with degree and some supervising experience for appointment as supervisor in county health department; 8 nurses on staff; entrance stipend $1,700. PH 12-8, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

PUBLIC HEALTH NURSES—(a) County department of health; minimum fifteen credits in advanced public health training required; $1,500 plus $300 travel allowance; year-round appointments; duties begin January 1, 1941. (b) School health nurse; must have C.P.H. degree; duties will begin immediately; about $150, including car allowance, after first of year; must be under 45, midsouthern city. (c) Public health nurse with Bachelor's degree capable teaching a generalized program to student nurses; $150 plus $35 car maintenance; central metropolis. (d) Public health nurse qualified to direct county-wide tuberculosis educational program; Illinois. PH 12-9, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

OUTPATIENT DEPARTMENT SUPERVISORS —(a) General hospital, fully approved, needs outpatient department supervisor who has had background in public health nursing; opportunity to completely reorganize department as hospital is increasing bed capacity to nearly 300; location particularly attractive to someone desiring to combine friendly small city atmosphere with accessibility to large metropolis. (b) Fully approved 200 bed hospital; department occupies ground floor space in light, sunny part of hospital building; experienced public health nurse desired for appointment as supervisor; salary open to discussion. PH 12–10, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

LABORATORY TECHNICIAN — Full-time appointment, state department of health; special training in technic of Kahn test for syphilis essential; duties will begin at once; entrance stipend $125. PH 12–11, Medical Bureau (M. Burneice Larson, Director), Palmolive Building, Chicago.

Situations Wanted

PUBLIC HEALTH PHYSICIAN — Young physician is available for public health appointment; B.S., M.D., M.P.H. (*cum laude*) degrees; several years rural health officer; 2 years, field epidemiologist; now completing graduate training in tuberculosis work; for further information please write M. Burneice Larson, Director, Medical Bureau, Palmolive Building, Chicago.

PUBLIC HEALTH NURSE—B. S., Columbia; graduate of New England training school; nearly 15 years' experience in public health nursing and social service work; 9 years, executive secretary and director of nursing, important organization; for further information please write M. Burneice Larson, Director, Medical Bureau, Palmolive Building, Chicago.

BACTERIOLOGIST — B.S., M.A., Ph.D., large university; splendid experience in teaching and research; 8 years, serologist, large hospital, metropolitan area; for further information please write M. Burneice Larson, Director, Medical Bureau, Palmolive Building, Chicago.

NEWS FROM THE FIELD

MENTAL HOSPITAL SURVEY BOARD

AN unofficial commission, headed by Homer Folks, Secretary of the State Charities Aid Association, was appointed on November 9 by Governor Herbert H. Lehman to make a survey of ways and means of reducing both the number of admissions to and the increasing population of New York State's mental institutions.

Outlining the matters for special studies which will be assigned to the commission, the Governor listed:

1. Newer modes of treatment — namely, insulin, metrazol and possibly other types of shock treatment.
2. The relation, present and future, of syphilis control to hospital census.
3. Increased and earlier use of parole.
4. Outside care, with payment for board, of a larger number of patients.
5. General matters of hospital administration.

In addition to Mr. Folks, chairman, those invited to serve on the commission, and listed by the Governor as experts in the field, are:

Dr. Karl M. Bowman
Dr. Clarence O. Cheney
Hester B. Crutcher
Stanley P. Davies
Dr. William J. Tiffany
Dr. Lawrence Kolb
Dr. Frederick W. Parsons
Dr. William L. Russell
Dr. Nolan D. C. Lewis
Dr. George S. Stevenson

The total inmate population of the state mental institutions, of which there are 27, is now about 90,000, and the cost of operation totals nearly $34,000,000 a year. The total inmate population has increased steadily from 64,294 in 1932 to its present peak.

GERONTOLOGY CONFERENCE

DR. THOMAS PARRAN, Surgeon General of the U. S. Public Health Service, has called a two day conference of the National Advisory Committee on Gerontology. The committee will consider the increasing significance of the older individuals in the national economy and defense growing out of the conspicuous shift to greater age in the population.

The Advisory Committee on Gerontology includes the following:

Dr. L. R. Thompson, Director, National Institute of Health, U. S. Public Health Service
Dr. Anton J. Carlson, Physiologist, University of Chicago
Dr. Charles L. Christiernin, Medical Director, Metropolitan Life Insurance Company; Association of Life Insurance Medical Directors of America
Dr. Robert E. Coker, Zoölogist, National Research Council, University of North Carolina
Dr. William Crocker, Botanist, Boyce Thompson Institute of Plant Research
Lawrence K. Frank, Sociologist, Josiah Macy Jr. Foundation
Dr. A. Baird Hastings, Biochemist, Harvard University
Dr. Ludvig Hektoen, Pathologist, Consultant, National Cancer Institute, U. S. Public Health Service
Dr. Winfred Overholser, Psychiatrist, Superintendent, St. Elizabeths Hospital
Dr. Clarence Selby, Industrial Physician, General Motors Corp.
Dr. William D. Stroud, Clinician, Philadelphia

BUREAU OF ANIMAL INDUSTRY CHANGES

THE Biochemical Division of the Bureau of Animal Industry of the U. S. Department of Agriculture has been merged with the Pathologic Division and the Animal Nutrition Division. The position of Chief of the Biochemical Division has not been filled since the recent death of Robert M. Chapin. Activities of the division relating to animal diseases were transferred to the Pathologic Division and those relating to the nutritive value of animal products were assigned to the Animal Nutrition Division, at the Beltsville Research Center, Beltsville, Md.

BUILDING HEALTH FOR DEFENSE

PRESIDENT ROOSEVELT, speaking on October 31 at the dedication of the new National Health Institute in Bethesda, Md., said:

> The total defense which this nation seeks involves a great deal more than building airplanes, ships, guns and bombs. We cannot be a strong nation unless we are a healthy nation. And so we must recruit not only men and materials but also knowledge and science in the service of national strength.
>
> The Public Health Service is a very old institution and has done magnificent work, but it is only recently that the Federal Government has indicated that it can do infinitely more—that disease disregards state lines as well as national lines—that among the states there is as we know an inequality of opportunity for health.
>
> Now that we are less than a day by plane from the jungle-type yellow fever of South America, less than two days from the sleeping sickness of Equatorial Africa, less than three days from cholera and bubonic plague, the ramparts we watch must be civilian in addition to military.

The President expressed thanks to Mr. and Mrs. Luke Wilson for having donated the grounds on which the Institute is situated, pointing out that it came as a gift to the nation in 1935.

NEW PRESIDENT AND DIRECTOR OF KELLOGG FOUNDATION

IT has been announced that George B. Darling, Dr.P.H., Associate Director, and Emory W. Morris, D.D.S., Associate Executive Director, were elected President, and General Director, respectively, of the W. K. Kellogg Foundation, Battle Creek, Mich., succeeding the late Dr. Stuart Pritchard, who held both positions.

The Foundation has announced a large program for the coming year to further the health and well-being of children, and the greater part of the work will be done in the Counties of Calhoun, Allegan, VanBuren, Barry, Branch, Eaton, and Hillsdale, where the Foundation conducts community health projects.

MEMORIAL TO DR. LAZEAR

WASHINGTON and Jefferson College, Washington, Pa., according to *Science*, dedicated on October 26 a new building for chemistry to the memory of Dr. Jesse W. Lazear who died in Cuba in 1900 of yellow fever while serving as a member of the Yellow Fever Commission in the U. S. Army. Dr. Lazear was an alumnus of the College. John R. Kissinger of Huntington, Ind., and John J. Moran of Havana, Cuba, two of the group of soldiers who allowed themselves to be bitten by mosquitoes during the investigation, were guests at the dedication ceremony.

AMERICAN SCHOOL HEALTH ASSOCIATION OFFICERS

THE American School Health Association has recently elected the following officers:

President, Amos L. Beaghler, M.D., Denver, Colo.
President-elect, Earl E. Kleinschmidt, M.D., Chicago, Ill.
Vice-Presidents, Helen A. Cary, M.D., Portland, Ore.; Lon W. Morrey, D.D.S., Chicago, Ill.
Executive Secretary-Treasurer, A. O. DeWeese, M.D., Kent State University, Kent, Ohio
Editor-in-Chief, Charles H. Keene, M.D., University of Buffalo, Buffalo, N. Y.

NEW JERSEY HEALTH AND SANITARY ASSOCIATION ELECTS NEW OFFICERS

NEW officers elected at the 66th Annual Meeting of the New Jersey Health and Sanitary Association, Inc., held November 15–16 at Asbury Park, N. J., are as follows:

President—L. VanD. Chandler, Hackensack
1st Vice-President—Joseph E. Raycroft, M.D., Princeton
2nd Vice-President—H. F. Kilander, Ph.D., East Orange
3rd Vice-President—Joseph H. Kler, M.D., New Brunswick
Secretary—Edward Guion, M.D., Northfield
Treasurer—Budd H. Obert, Asbury Park
Executive Secretary—John Hall, Freehold

DR. STAMPAR IN YUGOSLAVIA

THE friends of Dr. A. Stampar, formerly of the staff of the Health Section, League of Nations, will be interested to know that he is now Dean of the Medical School and President of the Student's Social and Health Services at Zagreb, Gvozd, Yugoslavia. He reports that Yugoslavia's health institutions have been kept alive during the present uncertain period. Dr. Stampar reports an acute lack of current information about medicine and public health in other countries.

PERSONALS

Eastern States

DR. JOHN W. CHAMBERLAIN, of Belmont, Mass., has been appointed Assistant Director of the Department of Hygiene at the Massachusetts Institute of Technology, Cambridge. He has been an assistant in the Department since 1937.

GEORGE LYNDE GATELY, M.D.,† of Boston, Mass., has been appointed Commissioner of Health of Boston, effective November 1, succeeding HENRY F. R. WATTS, M.D., resigned. Dr. Gately is a graduate of Tufts Medical School and has completed courses in public health at the Massachusetts Institute of Technology.

JOHN G. HARDENBERGH, V.M.D.,† has resigned as Director of Laboratories of the Walker-Gordon Laboratory Company, Inc., Plainsboro, N. J., with whom he has been associated since 1927. On January 1, 1941, he will become Executive Secretary of the American Veterinary Medical Association, with headquarters at 600 South Michigan Avenue, Chicago, Ill.

ALFRED KESSLER, M.S.P.H., a recent graduate from the DeLamar Institute of Public Health, Columbia University, New York, N. Y., has been appointed in health education with the Queensboro Tuberculosis & Public Health Association, New York, N. Y.

RALPH F. SIKES, M.D.,† formerly with the Connecticut State Health Department, has been appointed Senior Medical Supervisor in the Bureau of Venereal Diseases in the Health Department of Baltimore, Md.

Southern States

HUGH J. BICKERSTAFF, M.D.,† of Atlanta, Ga., Associate Director in the Division of Maternal and Child Health, State Department of Health, has resigned to become Associate Professor in Public Health Administration at the Johns Hopkins University School of Hygiene and Public Health, Baltimore, Md. He is succeeded by ALDEAN STARR INGRAM, of Atlanta.

PAUL A. NEAL, M.D.,* Surgeon U. S. Public Health Service, and a member of the staff of the National Institute of Health, Bethesda, Md., has been detailed as Chief of the Division of Industrial Hygiene of the Institute. He succeeds R. R. SAYERS, M.D.,* who went to the Bureau of Mines recently.

DR. JOHN B. PLUM, of Nashville, Tenn., has been appointed as Tuberculosis Clinician in the staff of the Alabama State Department of Health, succeeding DR. CHARLES J. WESTOVER, of Anniston, who resigned to enter private practice in Michigan.

DR. HOWE K. RIDDLE, of Coweta, Okla., has been appointed Health Officer of Wagner County, succeeding DR. WALTER R. JOBLIN, of Porter.

DR. RAYMOND E. SMALLWOOD, of Little Rock, Ark., has been named in charge of the Garland County Health Unit.

DR. ALBERT W. THOMPSON, of Bentonville, Ark., has been appointed Medical Director of the Benton County

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* Fellow A.P.H.A.
† Member A.P.H.A.

Health Unit, succeeding DR. JAMES B. TUCKER, resigned.

SIDNEY J. WILLIAMS, M.D., C.P.H.,† Health Officer of Sumter County, Livingston, Ala., has been appointed Director of the Commonwealth Fund Health Unit which has been established in Pike County, with offices in McComb, Miss.

DR. JOHN B. YOUMANS, of the School of Medicine, Vanderbilt University, Nashville, Tenn., is serving in Europe as a member of the Health Commission of the Rockefeller Foundation in charge of the nutritional phases of the health program. The announcement states that the work of the Commission will be in aid to the French in reëstablishing and reorganizing the health service of France.

* Fellow A.P.H.A.
† Member A.P.H.A.

Western States

DR. KEITH P. RUSSELL, of Portland, Ore., has been appointed Director of the Division of Communicable Disease Control in the Portland Department of Health.

JAMES R. SCOTT, M.D.,* formerly Professor of Health Education at the University of New Mexico, has been appointed State Director of Public Health of New Mexico, at Santa Fe, succeeding EDWIN B. GODFREY, M.D.†

Canada

DR. CHARLES W. MACMILLAN, of St. John, has been appointed Chief Medical Officer for the Province of New Brunswick.

CONFERENCES AND DATES

American Academy of Dermatology and Syphilology—3rd Annual Meeting. Palmer House, Chicago, Ill. December 8–11.

American Association for the Advancement of Science. Philadelphia, Pa. December 27–January 2.

American Camping Association — 18th Annual Convention. Wardman-Park Hotel, Washington, D. C. February 13–15, 1941.

American College of Physicians—25th Annual Session. Statler Hotel, Boston, Mass. April 21–25, 1941.

American Library Association. Midwinter Conference, Chicago, Ill., December 27–30. Annual Meeting, Boston, Mass., June 19–25, 1941.

American Medical Association — 92nd Annual Meeting. Cleveland, Ohio. June 2–6, 1941.

American Public Welfare Association. Round Table and Annual Meeting. Wardman-Park Hotel, Washington, D. C. December 4–8.

American Society for Public Administration. Chicago, Ill. December 29–30.

American Society of Civil Engineers. Winter Meeting—New York, N. Y., January 15–18. Spring Meeting—Baltimore, Md., April 23–26, 1941.

American Society of Heating and Ventilating Engineers—47th Annual Meeting. Hotel Muehlebach, Kansas City, Mo. January 27–29, 1941. (Summer Meeting—San Francisco, Cal., June 16–20, 1941.)

American Standards Association. New York, N. Y. December 11.

American Statistical Association. Chicago, Ill. December 26–28.

American Student Health Association—Annual Meeting. University of Michigan, Ann Arbor, Mich. December 27–28.

American Water Works Association—61st Annual Convention. Royal York Hotel, Toronto, Ont., Canada. June 22–26, 1941.

New York Section — Commodore Hotel, New York, N. Y. December 27.

New York Section—Syracuse, N. Y. March 20–21, 1941.

Pacific Northwest Section—Seattle, Wash. May 8–10, 1941.

Ohio Section—Cincinnati, Ohio. May 15–16, 1941.

Southwest Section—Fort Worth, Tex. October 13–16, 1941.

Canadian Public Health Association—Laboratory Section. Ninth Annual Christmas Meeting. Royal York Hotel, Toronto, Ont. December 16–17.

Florida Public Health Association. Tampa, Fla. December 5–7.

Heating, Piping & Air Conditioning Contractors National Association. San Francisco, Calif. June 16–20, 1941.

National Chemical Exposition and Industrial Chemical Conference (1st Biennial). Under the auspices of the Chicago Section of the American Chemical Society. Stevens Hotel, Chicago, Ill. December 11–15.

National Council of State Public Assistance and Welfare Administrators. Washington, D. C., December 4–8.

National Public Housing Conference. New York, N. Y. January 24–26.

National Society for the Prevention of Blindness. New York, N. Y. December 12.

Pacific Heating and Air Conditioning Exposition. Exposition Auditorium, Civic Center, San Francisco, Calif. June 16–20, 1941.

Second Southern Conference on Tomorrow's Children. Under the auspices of the University of North Carolina. Chapel Hill and Durham, N. C. December 5–7.

Smoke Prevention Association of America, Inc.—35th Annual Convention. Ansley Hotel, Atlanta, Ga. June 3–6, 1941.

Society of American Bacteriologists. Jefferson Hotel, St. Louis, Mo. December 27–29.

Society of Illinois Bacteriologists. Chicago, Ill. January 31.

University of Chicago, Chicago, Ill. Fiftieth Anniversary Year: October 1, 1940–September, 1941.

Western Branch, American Public Health Association — 12th Annual Meeting. San Diego, Calif. May 26–30, 1941.

Foreign

International College of Surgeons. Mexico City, Mexico. August 10–13, 1941.

KNOWLEDGE

Helping thousands of frightened people to regain their peace of mind ...this is one of the most constructive services of the New York City Cancer Committee of the American Society for the Control of Cancer.

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MEETINGS OF AFFILIATED SOCIETIES
and A.P.H.A. Branches

Society and Secretary	Next Meeting
ARIZONA PUBLIC HEALTH ASSOCIATION Marion E. Stroud, Room 100, Arizona State Bldg., Phoenix.	To be announced
COLORADO PUBLIC HEALTH ASSOCIATION Helen Cannon, 3136 York St., Denver, Colo.	To be announced
CONNECTICUT PUBLIC HEALTH ASSOCIATION Mario L. Palmieri, 43 S. Main St., Middletown	To be announced
CUBAN PUBLIC HEALTH SOCIETY Dr. Carlos Pineiro, Instituto Finlay, Havana, Cuba.	To be announced
FLORIDA PUBLIC HEALTH ASSOCIATION Edward M. L'Engle, M.D., State Board of Health, Jacksonville.	To be announced
GEORGIA PUBLIC HEALTH ASSOCIATION D. C. Fowler, 245 State Office Building, Atlanta.	To be announced
IDAHO PUBLIC HEALTH ASSOCIATION Herbert C. Clare, State Division of Public Health, Boise	To be announced
IOWA PUBLIC HEALTH ASSOCIATION Carl F. Jordan, M.D., State Department of Health, Des Moines, Ia.	To be announced
MASSACHUSETTS PUBLIC HEALTH ASSOCIATION G. Donald Buckner, 69 Coolidge Avenue, Needham.	To be announced
MICHIGAN PUBLIC HEALTH ASSOCIATION Marjorie Delavan, State Department of Health, Lansing.	To be announced
MISSOURI PUBLIC HEALTH ASSOCIATION John W. Williams, Jr., M.D., State Board of Health, Jefferson City.	To be announced
NEW MEXICO PUBLIC HEALTH ASSOCIATION Frank W. Parker, Jr., M.D., P. O. Box 1086, Santa Fe, N. M.	To be announced
NORTHERN CALIFORNIA PUBLIC HEALTH ASSOCIATION Margaret Blee, Instructor in Nursing Education, University of California, Berkeley, Calif.	To be announced
OHIO FEDERATION OF PUBLIC HEALTH OFFICIALS W. D. Bishop, M.D., Darke County Health Unit, Greenville.	To be announced
PENNSYLVANIA PUBLIC HEALTH ASSOCIATION C. E. Houston, Department of Public Health, Washington, Pa.	To be announced
PUBLIC HEALTH ASSOCIATION OF NEW YORK CITY Frank Kiernan, 386 Fourth Avenue, New York.	To be announced
SOUTH CAROLINA PUBLIC HEALTH ASSOCIATION Ruth George, State Board of Health, Columbia.	To be announced
SOUTHERN CALIFORNIA PUBLIC HEALTH ASSOCIATION Eunice Lamona, R.N., 6028 Harcourt Ave., Los Angeles.	To be announced
TENNESSEE PUBLIC HEALTH ASSOCIATION Dr. Robert H. Hutcheson, State Department of Health, Nashville.	To be announced
TEXAS PUBLIC HEALTH ASSOCIATION P. A. Kerby, State Department of Health, Austin.	To be announced
UTAH PUBLIC HEALTH ASSOCIATION S. E. Gilchrist, 105 South State St., Salt Lake City, Utah.	To be announced
WEST VIRGINIA PUBLIC HEALTH ASSOCIATION Dorothea Campbell, State Department of Health, Charleston.	To be announced
SOUTHERN BRANCH, A.P.H.A. P. E. Blackerby, M.D., 559 Sunnyside Drive, Louisville, Ky.	To be announced
WESTERN BRANCH, A.P.H.A. W. Ford Higby, 45 Second Street, San Francisco, Calif.	San Diego, Calif., May 26–30, 1941

Request for Application for Membership

I wish to apply for membership in the American Public Health Association. Please send me an application blank.

Name.....

Print name in full and give degree

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Present public health occupation.....

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AMERICAN PUBLIC HEALTH ASSOCIATION
1790 BROADWAY AT 58TH STREET, NEW YORK, N. Y.

SUPPLEMENT TO AMERICAN JOURNAL OF PUBLIC HEALTH
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DIPHTHERIA STUDIES

made by the

SUB-COMMITTEE ON DIPHTHERIA

of the

COMMITTEE ON EVALUATION OF ADMINISTRATIVE PRACTICES

Sub-Committee on Diphtheria

D. T. FRASER, M.B., D.P.H., *Chairman*

WILLIAM EDWARD BUNNEY, PH.D.
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VLADIMIR K. VOLK, M.D., *Secretary*

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Committee on Evaluation of Administrative Practices

Introduction

THREE years ago a few so-called advisers and experts were invited to attend a meeting at Battle Creek, Mich. It is very fitting to take this opportunity of formally thanking the W. K. Kellogg Foundation for the financial aid which it has so generously given. These advisers were asked to propose certain studies in various fields, including that of diphtheria, which might be profitably undertaken.

At that time the practices in the administration of diphtheria prophylactics for active immunization in this country were far from uniform. Studies had been in progress in Toronto for a few years on a modest scale to assess the antitoxin response in children to various preparations of toxoid variously used. It seemed an excellent opportunity to carry out a similar scheme on a more comprehensive scale. In the State of Michigan, consequently, a well controlled experiment of suitable magnitude was undertaken. It was proposed to compare the antitoxin response in children to 2 doses of fluid toxoid, 3 doses of fluid toxoid, and 1 dose alum precipitated toxoid. Later the investigation was extended to include 2 doses of alum precipitated toxoid.

I shall not have time to review this phase of the work in the detail which it merits. Certain requirements were essential. The environment must be free of diphtheria and attested to by carefully conducted and extensive carrier surveys. The children must have no detectable (less than 1/1,000 unit) antitoxin, at the time of the first injection; blood samples must be obtained at stated intervals thereafter. The results of this carefully executed but not completed piece of work have been fully reported by Dr. Bunney and Dr. Volk.

Your committee from the outset clearly appreciated the limitations of that study. On the one hand the relative superiority of one antigen, used in a particular way, over another was clearly demonstrated. However, to translate these findings into recommendations for administrative practice is quite another matter. The much more important question of how effective in a given community is such and such a method in the prevention of diphtheria, remained and remains unanswered. Only carefully controlled epidemiological studies carried out for a long period of time under field conditions can give the answer. Consequently other projects were initiated. The committee was fortunately able to call upon outstanding epidemiologists and other experts to guide us and assist in the work. Some of their reports will be presented here.

I should like in the brief time at my disposal to stress certain aspects of diphtheria about which we know very little. I trust my colleagues will make that clear in the report of their work which follows.

In a diphtheria environment the natural process of immunization goes on, on a large scale, through infection with the diphtheria bacillus. A few children manifest clinical diphtheria and very few succumb; the majority of those infected with the diphtheria bacillus remain presumably symptomless. Nothing is known of the most useful kind of protection or immunity, if one may use the term in this loose manner. We come back to that hardy perennial—Is it the seed or the soil that plays the dominant

rôle? Is the acquisition of antitoxin the result of one infection or of many? Is it produced quickly or slowly? How long does the carrier state last? Are carriers readily and surely detectable by the means at our disposal?

What level of antitoxin is sufficient to protect against diphtheria? Is it the Schick level, 1/250 unit? Is it much less, say 1/1,000 unit? Is it 1/100 unit? Does the immunity mechanism once attuned by a previous diphtheria experience, naturally or artificially acquired, respond rapidly enough to ward off a clinical attack sometimes, generally, or always? Why do some children given what one considers an adequate dosage of antigen contract diphtheria? Have they never responded? Has their antitoxin level dropped to the point where antitoxin is no longer adequate for protection? Why does the antitoxin level in artificially immunized children invariably drop and in contrast remain relatively constant in those "naturally" immunized?

I believe some of these questions will be answered through the results of the studies already undertaken and those proposed provided they are long enough pursued.

D. T. FRASER, M.B., D.P.H.

Foreword

CONTROL of communicable diseases depends increasingly upon knowledge of the prevalence and whereabouts of carriers and of the distribution of immunes and susceptibles in the population, as well as upon the reporting of recognized and suspected cases of a particular infection.

Lack of any reasonably adequate biological survey of pathogenic bacteria such as we have for many of the fauna and flora of our continent has forced those concerned with further refinements in the administrative control of diphtheria to seek for evidence as to the regional uniformity or variance in the distribution and type of *Corynebacterium diphtheriae* as a prerequisite for wise policies and methods of active immunization of children in the United States.

The studies presented by the several authors of the symposium were undertaken at the request of the Committee on Evaluation of the Committee on Administrative Practice to make a year's study in their respective state or city populations of carriers and the immunity status among school children. Uniformity of procedures, methods, materials, and technics was agreed upon and all carrier cultures were submitted to a central laboratory for determination of type and cultural and other characteristics.

Quite apart from, and in addition to, the accumulation of new information of a necessary and highly reliable type, this coöperative undertaking has revealed some of the possibilities of interchange of experience and the methodical cultivation of parallel but widely scattered natural phenomena accessible chiefly if not solely through local and state health departments.

It is the intention of the collaborating authors of this symposium to broaden their field of experience to include Colorado, Washington, and California, and extend their observations over at least one more year, so that a base line or status quo in the biological sense may be drawn for purposes of comparison in later years.

So much service and devotion was applied to this study by the staffs of the various divisions and laboratories of health departments and universities concerned that relatively small supplementary funds were called for to meet expenses not properly chargeable to the resources of the respective agencies. Such sums as were required were made available through the budget of the Committee on Administrative Practice from grants made for this purpose by the W. K. Kellogg Foundation.

It is the plan of the Committee on Evaluation to encourage and within its means to assist the development of similar collaboration among health departments for the solution of the many other problems where administrative efficiency awaits more precise scientific evidence as to methods and results.

HAVEN EMERSON, M.D.

A Schick Test and Diphtheria Carrier Survey of White School Children in Virginia

WILLIAM GROSSMANN, M.D.

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IN coöperation with the Diphtheria Sub-Committee of the Committee on Evaluation of Administrative Health Practices, and with financial assistance from this body, a study to determine the incidence of *Corynebacterium diphtheriae* carriers and the immunity status of white children in Virginia was undertaken. In view of the peculiar local variations which occur in diphtheria, as well as the many known factors which influence the prevalence of this disease, and the development of naturally acquired immunity against it, the difficulty of obtaining a representative sample of the school population of a state the size of Virginia is obvious. The study was planned, however, to include areas which are believed to represent fairly typical examples of geographical, economic, and environmental differences, which might be expected to influence the results of such an investigation. Sixteen schools within 6 counties and 5 schools within 2 cities were selected for the survey.

Richmond, the largest city and capital of the state, with a population of 184,900, is the commercial center of Virginia. Norfolk, the second largest city, with a population of 129,710, is one of the leading ports on the Atlantic Seaboard. Arlington County, with a population of 50,000 and an area of 31 sq. miles, consists principally of suburban homes. It is situated adjacent to Washington, D. C., on the Potomac River. Fairfax County, with a population of 32,000 and an area of 416 sq. miles, is a progressive dairy, fruit, and trucking county, located in the northern border of middle Virginia adjacent to Arlington. There is free intercommunication in the county and there has been extensive consolidation of the public schools. Hanover, with a population of 17,009 and an area of 512 sq. miles, is strictly an agricultural county. It is located about 15 miles from Richmond and comprises parts of the middle and tidewater provinces of the state. Improved county roads have left few isolated sections in this area. Prince George County, with a population of 23,311 and an area of 294 sq. miles, is a typical county of the peanut belt in the tidewater province. Intercommunication is considerably more limited than the areas previously mentioned, though few isolated sections are to be found. An industrial city of 13,000 population was not included in the study. Pittsylvania County, with a population of 61,500 and an area of 1,015 sq. miles, is located in the south central part of the state, bordering North Carolina. It is in the tobacco and cotton section. Relatively isolated sections exist in this

county and intercommunication is considerably limited. Pulaski County, with a population of 20,700 and an area of 333 sq. miles, lies in the Great Valley of Southwest Virginia, between the Blue Ridge and Appalachian Ranges. One town with a population of 7,168 which was excluded from the study is the only semblance to urban life in the county. The rest of the area is strictly rural, and many isolated mountainous and valley sections are to be found.

Nose and throat cultures were obtained from 3,773 children in these areas. Schick tests were also performed on 2,329 of these same individuals. Of the number cultured, 1,444 either did not receive a Schick test or were absent on the day the tests were read, and their immunity status, therefore, remains unknown. Likewise, 116 individuals received a Schick test, but were not cultured or their cultures were eliminated from the study because of various accidents and errors attendant upon their examination in the laboratory. Thus a total of 2,329 individuals received both a Schick test and nose and throat culture, 1,444 a culture only, and 116 received Schick test only, giving a total of 3,773 individuals cultured, and 2,445 Schick tested. These observations were carried out from October 18, 1937, through February 28, 1938, and from October 17, 1938, through April 4, 1939.

METHODS

Two sterile swabs were used for obtaining material for culture from each child; one for the tonsillar crypts or fossae, and the other passed to the nasopharynx or as near the nasopharynx as the individual would permit. Both swabs were kept together in a sterile tube and stroked on Loeffler's medium within 3 hours after swabbing. The procedure of pure culture identification of *Corynebacterium diphtheriae* using cystine-tellurite media as outlined by the referee on bacteriological methods, Dr. Martin Frobisher, Jr., was followed. Each lot of plating media was tested before use by plating the routine diagnostic swabs received in the laboratory of the Virginia Department of Health and also by plating stock cultures of *Corynebacterium diphtheriae*. Suspicious as well as typical colonies appearing on the cystine-tellurite plating media were transferred to Loeffler's slants. Organisms which resembled *Corynebacterium diphtheriae* morphologically on this media and which gave the characteristic reactions of fermenting dextrose, but not saccharose, were identified as positive cultures. These were tested for virulence by inoculating 0.2 cc. of a 72 hour broth culture intracutaneously in the ventral skin of guinea pigs. Those reacting with redness, swelling, and necrosis in 48 hours were classified as virulent; those with no reaction or the minimal reaction characteristic of needle trauma were considered avirulent.

The Schick tests were administered on the same day that cultures were obtained. A standard toxin supplied by The Connaught Laboratories of Toronto was used in these tests. All tests were read on the 7th day with the exception of 36 which were read on the 8th. The reactions to both the toxin and the heated toxin (also supplied by The Connaught Laboratories) used as a control were measured in millimeters in the horizontal and perpendicular diameters. The test was considered positive if a definite reaction characterized by discoloration, either with or without induration and scaling, was observed at the site of the toxin inoculation and no reaction was observed at the site of the control (heated toxin). The test was also considered positive if reactions to both the toxin and the control were observed and one or both diameters of the toxin reaction exceeded the corresponding diameter of the control reaction by as much as 3 mm. or more. In

TABLE 1

Reactions to Schick Test of 2,445 White School Children in Virginia, According to History of Previous Inoculation against Diphtheria, 1937–1939

Age Group, Years	History of Previous Inoculation against Diphtheria: Number Tested	Schick-negative: Number	Schick-negative: Per cent	No History of Previous Inoculation against Diphtheria: Number Tested	Schick-negative: Number	Schick-negative: Per cent	Total: Number Tested	Schick-negative: Number	Schick-negative: Per cent
0– 4	6	2	33.3	2	1	50.0	8	3	37.5
5– 9	614	416	67.8	541	300	55.4	1,155	716	62.0
10–14	777	650	83.6	428	278	65.0	1,205	928	77.0
15 and older	43	38	88.4	25	19	76.0	68	57	83.8
Age not recorded	2	0	0.0	7	2	28.6	9	2	22.2
Total	1,442	1,106	76.7	1,003	600	59.8	2,445	1,706	69.8

a very few instances, where the reactions to both toxin and control were of equal and large size and definite scaling was present over the area of the toxin, but not observed over the control site, the test was classified as positive.

Inquiry was made of each individual in regard to previous inoculation against diphtheria and previous Schick status and the information recorded. Verification by health department and school records and other sources was obtained wherever possible.

RESULTS OF SCHICK TESTS

The Schick reactions of the 2,445 children tested in this study are shown in Table 1. Those from whom a history of previous inoculation against diphtheria was obtained, either with or without definite records to substantiate such claims, are included in the previously inoculated group. Those giving no history of previous inoculation, as well as a smaller number relating an unknown or questionable history, in regard to immunizing treatments, are classified in this table as uninoculated. Any attempt further to classify the inoculated group, according to kind of immunizing agent, the number of inoculations received, or the interval of time between inoculation and the present testing, results in too few observations for each such category to be of significance. Thus in the inoculated group are included all those who, either by history or by record, have been given some kind of immunizing treatment against diphtheria at some time prior to the present investigation. Approximately 70 per cent of all children tested gave negative reactions to the Schick test, 77 per cent of those previously inoculated,

TABLE 2

Reactions to Schick Test of 1,886 White School Children in Hanover, Prince George, and Pulaski Counties and the City of Norfolk, Virginia, According to History or Record of Previous Inoculation against Diphtheria, 1937–1938

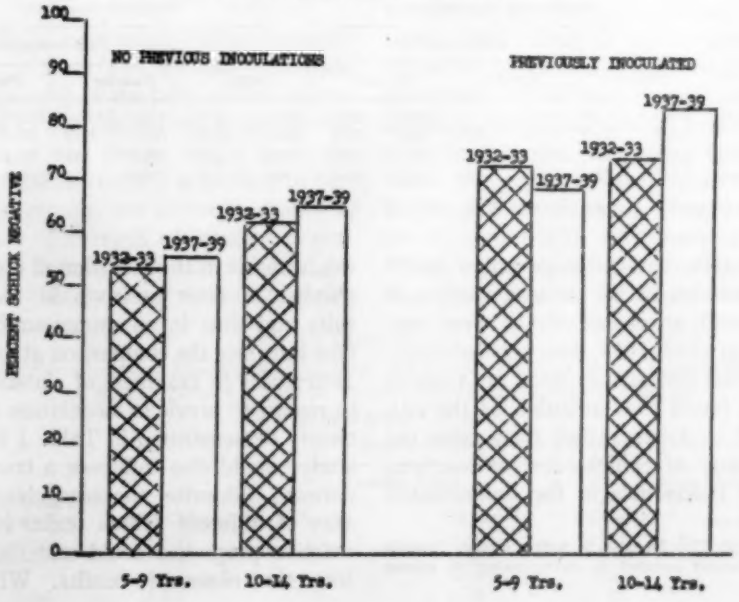
Age Group, Years	Previously Immunized or Inoculated: Record of Inoculation and Neg. Post-Schick: Number Tested	Schick Neg.: No.	Schick Neg.: %	Record of Inoculation No Post-Schick Record: Number Tested	Schick Neg.: No.	Schick Neg.: %	History of Inoculation No Record: Number Tested	Schick Neg.: No.	Schick Neg.: %	No Previous Inoculation: No History of Previous Inoculation: Number Tested	Schick Neg.: No.	Schick Neg.: %	Inoculation History Unknown or Indefinite: Number Tested	Schick Neg.: No.	Schick Neg.: %
5– 9	81	73	90.1	90	70	77.8	288	201	69.8	351	177	50.4	74	52	70.3
10–14	244	225	92.2	99	91	91.9	279	231	82.8	225	154	68.4	95	62	65.3
15 and older	11	11	100.0	2	2	100.0	24	21	87.5	12	9	75.0	11	9	81.8
Total	336	309	92.0	191	163	85.3	591	453	76.6	588	340	57.8	180	123	68.3

and 60 per cent of those uninoculated. The percentage of Schick-negatives by age groups in each classification is shown.

That the classification adopted in regard to previous artificial immunization experience underrates the frequency with which immunity is promoted by such procedures, may be seen in Table 2, which shows the reactions to the Schick test of 1,886 children on whom more accurate information as to previous inoculations was obtained from health department and school records. Among the previously inoculated group, the frequency of Schick-negatives is greatest for those known to have been rendered Schick-negative by previous inoculation (92 per cent), and lowest in the group having no record of immunizing treatment (76.5 per cent). Of those known by record to have been inoculated, but having no subsequent Schick test, 84.9 per cent were found to be negative in this study. It is, also, of interest that among the uninoculated group a higher percentage of Schick-negative reactions was observed in those who gave questionable or unknown histories in regard to previous immunizing treatments (68 per cent) than in the group definitely stating that they had received no previous inoculations (58 per cent).

It is interesting to compare the results of the Schick reactions of this study with those of McGinnes and Stebbins in Virginia in 1932 and 1933.[1] In their investigation they Schick tested approximately 10,000 white school children in 5 counties, 2 of which were also included in the present survey. Schick test toxin obtained from a commercial biological house was used in their work and it is stated in their report that a control of heated toxin was used in 3,000 of the tests. In 1932–1933 approximately 30 per cent of the children studied had received some kind of immunizing treatment prior to testing, the majority of such treatments being toxin-antitoxin though a few had received fluid toxoid. In the present investigation approxi-

FIGURE 1—Comparison of Schick Reaction in White School Children in Virginia in 1932–1933 and 1937–1939



mately 55 per cent had previously been inoculated, the majority of such inoculations, which could be definitely classified as to kind, were alum precipitated toxoid. A comparison of the Schick reactions in the 1932–1933 study of McGinnes and Stebbins with the 1937–1939 study is shown in Table 3 and graphically in Figure 1. Remarkably close agreement among the previously uninoculated children in both the age group 5–9 years and the 10–14 year group may be seen. For the 5–9 year group, 54 per cent were found Schick-negative in 1932–1933 and 55 per cent in 1937–1939. In the 10–14 year group, 62 per cent and 65 per cent were Schick-negative in the two respective studies. It would appear, therefore, that *there has been no appreciable change in the rate of development of naturally acquired immunity against diphtheria in Virginia between the times of the two respective studies.*

group. In regard to the children giving a history of previous inoculation, however, no such agreement was found. In the age group 5–9 years, McGinnes and Stebbins found 73 per cent Schick-negative, and the 1937–1939 study showed 68 per cent negative. This difference proves to be greater than one would expect from chance variation alone in samples the size of those represented by the two studies ($^z/_\sigma = 2.3$). In the age group 10–14 years 75 per cent were found to be Schick-negative in 1932–1933 and 84 per cent in 1937–1939. This difference is likewise statistically significant ($^z/_\sigma = 5.08$).

In evaluating the differences observed in the previously inoculated groups, due consideration must be given certain possible variables which may have resulted in these differences being more apparent than real. The fact that control tests were not used on all of the observations in the study of McGinnes and Stebbins

TABLE 3

*Reactions to Schick Tests of White School Children in Virginia in 1932–1933 * and in 1937–1939, According to Status of Previous Inoculation against Diphtheria*

	No Previous Inoculation						*Previously Inoculated*					
	Number Tested		*Schick-negative*				*Number Tested*		*Schick-negative*			
			Number		*Per cent*				*Number*		*Per cent*	
Age Group	*1932–1933*	*1937–1939*	*1932–1933*	*1937–1939*	*1932–1933*	*1937–1939*	*1932–1933*	*1937–1939*	*1932–1933*	*1937–1939*	*1932–1933*	*1937–1939*
5- 9 years	2,459	541	1,317	300	53.6	55.5	1,016	614	743	416	73.1	67.8
10–14 years	1,827	428	1,139	278	62.3	65.0	2,057	777	1,534	650	74.6	83.7

* McGinnes, G. F., and Stebbins, E. L. *A.J.P.H.*, 24, 4 (Apr.), 1934.

The fact that one large urban area * was included in the present study and that rural areas exclusively were surveyed in 1932–1933, does not materially affect the comparison since on analysis it was found that inclusion of the city tended to lower rather than raise the percentage of Schick-negative reactions among individuals in the uninoculated

would result in the inclusion of a certain number of false positives in their results and thus in an unmeasurable degree influence the comparison attempted. Differences in exactness of classification in regard to previous inoculation status, clearly demonstrated in Table 2 for this study, would also influence a true comparison. Likewise, the recognized variance of different Schick toxins in their reaction properties could materially affect the observed results. Whatever

* Norfolk City included in Schick survey. Norfolk and Richmond included in carrier survey of present study.

TABLE 4

Results of Bacteriological Examinations of Nose and Throat Cultures for C. Diphtheriae from 3,773 White School Children in Virginia, 1937–1939, According to Certain Age Groups

Age Group, Years	Number Cultured	Number Positive for C. Diphtheriae			
		Avirulent Strain		Virulent Strain	
		Number	Per cent	Number	Per cent
0– 4	2	0	0.0	0	0.0
5– 9	1,912	23	1.2	11	0.6
10–14	1,673	17	1.0	6	0.4
15 and older	151	0	0.0	0	0.0
Unknown	35	0	0.0	0	0.0
Total	3,773	40	1.1	17	0.5

error may arise from individual differences in the administration and interpretation of the tests, however, may be considered relatively constant and the same for both of these investigations, since the greater majority of the tests and readings in each were performed by the same individual (G. F. McGinnes). Therefore, though we are inclined to believe that an actual difference does exist between the results of the two studies, particularly in the age group 10–14 years, since the information concerning their previous inoculation was more reliable and more often confirmed by records, we would hesitate to draw any definite conclusions in this regard.

RESULTS OF BACTERIOLOGICAL EXAMINATIONS OF NOSE AND THROAT CULTURES

The results of the pure culture identification of *Corynebacterium diphtheriae* from nose and throat swabs from the 3,773 children studied, according to certain age groups, are shown in Table 4. The rate of carriers of virulent organisms was found to be *0.5 per cent for the total study and for avirulent strains 1.1 per cent.* There is no appreciable difference between the two age groups 5–9 and 10–14 years. There was, likewise, rather close uniformity in the rate of carriers detected in the 1937–1938 season and in 1938–1939. In the first named period a rate of 0.5 per cent for virulent strains and 1.2 per cent for avirulent strains and for the 1938–1939 period 0.4 per cent virulent, and 0.9 per cent avirulent. Unfortunately, there are no comparable studies of carrier incidence previously performed in Virginia with which to compare the present findings.

Table 5 shows the results of cultures from 2,329 children according to Schick reaction at the time the nose and throat swabs were taken. It can be seen that 12 of the 13 virulent strains of *Corynebacterium diphtheriae* were found in Schick-negative individuals, resulting in a virulent carrier rate approximately 5 times as great as that observed in Schick-positive children. These findings are in accord with the observations of others. Because of the small number of observations of the study, however,

TABLE 5

Results of Bacteriological Examinations of Nose and Throat Cultures for C. Diphtheriae from 2,329 White School Children in Virginia, According to Schick Reaction at Time of Taking Culture

Schick Reaction at Time of Taking Culture	Number Cultured	Number Showing Positive Culture for C. Diphtheriae			
		Avirulent Strain		Virulent Strain	
		Number	Per cent	Number	Per cent
Negative	1,677	20	1.19	12	0.72
Positive	652	10	1.53	1	0.15
Total	2,329	30	1.29	13	0.56

TABLE 6

Summary of Schick Test and Diphtheria Carrier Survey in Virginia, 1937–1939

County or City	Schick Reactions: Previously Inoculated — Number Tested	Schick Reactions: Previously Inoculated — Per cent Negative	Schick Reactions: No Previous Inoculation — Number Tested	Schick Reactions: No Previous Inoculation — Per cent Negative	Per cent Inoculated Prior to Study	Results of Cultures for C. Diphtheriae: Number Cultured	Number Positive: Avir. — No.	Avir. — %	Vir. — No.	Vir. — %	Dates of Taking Cultures	Diphtheria Morbidity Rates *: Aver. 1933–1937	1937	1938	Diphtheria Mortality Rates *: Aver. 1933–1937	1937	1938
Hanover	314	89.2	202	68.8	61	532	9	1.7	0	0.0	Oct. 18 to Nov. 8, 1937	85.8	17.6	23.5	4.7	0.0	0.0
Prince George	361	85.6	138	65.2	72	514	9	1.8	3	0.6	Jan. 31 to Feb. 28, 1938	30.0	12.9	38.6	0.9	0.0	0.0
Pulaski	286	76.6	196	62.8	59	515	3	0.6	7	1.4	Nov. 12 to 23, 1937	101.4	222.2	231.9	6.8	9.7	14.5
Norfolk City	159	73.6	232	47.8	41	419	3	0.7	0	0.0	Dec. 10, 1937	18.5	13.1	18.5	1.1	0.0	2.3
Arlington	184	33.2	136	56.6	58	190	0	0.0	1	0.5	Oct. 17, 1938	23.6	4.0	16.0	0.0	0.0	0.0
Pittsylvania	138	87.0	99	60.6	58	243	7	2.9	2	0.8	Nov. 7, 1938	73.8	37.4	167.5	3.3	0.0	6.5
Fairfax	...	....	...	....	..	500	0	0.0	0	0.0	Mar. 30 to Apr. 4, 1939	33.8	9.4	37.5	2.5	0.0	0.0
Richmond City	...	....	...	....	..	860	9	1.1	4	0.5	Dec. 9 to 20, 1938	30.2	14.1	22.2	2.1	1.1	1.1
Total	1,442	76.7	1,003	59.8	55	3,773	40	1.1	17	0.5	State of Virginia	66.7	52.5	72.6	5.6	3.6	4.9

* Rate per 100,000 population

TABLE 7

Results of Titrations for Diphtheria Antitoxin of 124 Blood Sera Obtained from White School Children in Virginia, According to Age and Schick Reaction at Time of Bleeding

Age Group, Years	Blood > 1/100 Unit Antitoxin				Blood < 1/100 Unit Antitoxin			
	Schick-negative	Doubtful Schick-negative	Schick-positive	Doubtful Schick-positive	Schick-negative	Doubtful Schick-negative	Schick-positive	Doubtful Schick-positive
5–9	19	1	0	1	0	0	5	0
10–14	66	1	3	3	0	1	17	1
15 and older	4	0	2	0	0	0	0	0
Total	89	2	5	4	0	1	22	1
	91		9		1		23	

there may be an error attributable to the small sample ($^x/_\sigma = 1.66$). There is no appreciable difference in the rates for avirulent carriers between Schick-positive and Schick-negative children.

Table 6 presents a brief summary of the results of the Schick tests and culture identifications of this study and includes the recorded diphtheria morbidity and mortality rates for each area included in the survey. No attempt has been made to correlate the findings nor does such a correlation appear evident. It is interesting, however, that the rate of virulent carriers was found to be highest in the two areas (Pulaski and Pittsylvania) which experienced the highest attack rate and mortality from diphtheria during the year in which they were studied.

Table 7 shows the results of titrations of diphtheria antitoxin in blood sera obtained from 124 children in this study at the time of administering the Schick tests. Blood samples were collected in sterile Kimble tubes, the serum drawn off under aseptic conditions and stored at 46° F. without preservative until testing was performed 6 to 8 months later. The titrations were performed only at the 1/100 unit level since it was not intended to establish any high degree of correlation between the two observations but rather to serve as a rough check on the immunity status as measured by the Schick test toxin used in the investigation. The toxin used in the titration experiments was supplied by Dr. Martin Frobisher, Jr., and contained 65 Lr per cc. This toxin gave a satisfactory reaction in guinea pigs when diluted 1:650 with a standard antitoxin (6 units per cc.) diluted 1:600. In Table 7 Schick reactions which have been classified as doubtful are those which could conceivably have been interpreted as positive or negative by other observers, but which were considered as definitely one or the other in this study, e.g., doubtful Schick-positives were called positives.

It can be seen from the figures presented that, though agreement between the two types of observations was lacking in 9 per cent of the instances where the blood sera contained more than 1/100 unit of antitoxin, there is, nevertheless, as close a correlation as one might expect from single observations of titrations performed at one level only. From these findings it would appear that whatever error may exist in regard to the Schick toxin used in the study, would be toward the safety of the individual concerned in the interpretation of his immunity status by this test, since the reaction may occasionally appear positive although the individual had more than 1/100 unit of antitoxin.

REFERENCES

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NOTE: The author is indebted to Dr. G. Foard McGinnes for assistance in the formulation and conduct of this study, and to Dr. Kenneth F. Maxcy for advice and help in the preparation of the report.

Diphtheria Infection and Morbidity in Cleveland, 1937-1939*

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FOLLOWING a period of high mortality, unprecedented in the statistical record and exceeding 300 per 100,000 in 1877, the decline of diphtheria in Cleveland was heralded by a precipitate fall in the death rate in 1879. After 5 years at a level of about 180, a gradual decline commenced, which continued, with some interruptions, to 1909, when the rate was 12.4. In the succeeding 18 years, with the exception of 1924, higher rates were experienced. Then, after 1927, the decline was resumed and greatly accelerated. Since 1930 mortality has been at a very low level. In 1938 the rate was only 0.5, a reduction of 97 per cent from that of 1927.

The number of cases reported in each year, since 1910, has varied directly with the number of deaths. Thus there has been no evidence of decreasing severity of the disease. The case fatality was 7.6 per cent for the period 1910–1914; 7.9 for 1915–1919; 8.2 for 1920–1924; 7.2 for 1925–1929; 7.0 for 1930–1934, and 8.5 for 1935–1938. The great reduction in morbidity may be illustrated further by the fact that, in 1927, 2,872 cases were reported and, in 1938, only 77.

With the possible exception of the more or less constant case fatality rates, a closely similar diphtheria history might be presented for most large cities in the United States and indeed for most areas of the United States and Europe for which adequate records have been kept. The great decline in mortality, the early date at which it was manifested, and the widespread area over which it has been experienced, all go to indicate that it is attributable largely to causes other than specific treatment and immunization. The remarkable reduction in morbidity and mortality since 1927, if viewed as a separate phenomenon, might be attributed in part at least to artificial immunization. That this has been a major factor, however, would seem to be quite improbable, as the recent acceleration of the decline has likewise been experienced over a wide area and, even in many cities in which immunization has been most extensively practised, the reduction has been far greater than can be satisfactorily explained by the numbers of persons immunized. Viewing all the available facts, the conclusion seems inevitable that other factors have played a major rôle.

* The studies on which this report is based received financial support from the Committee on Administrative Practice of the American Public Health Association. Carrier and Schick testing surveys were made with the assistance of Dr. Joyce I. Hartman, Chief Medical Officer of the Cleveland Board of Education, and his staff. Data on prevalence and mortality were furnished by Dr. H. J. Knapp, Commissioner of Health, and Dr. R. J. Ochsner, Chief of the Bureau of Child Hygiene, Cleveland Division of Health. For advice and assistance on bacteriological aspects, the authors are especially indebted to Dr. Martin Frobisher, Jr.

From a theoretical point of view, variations in the prevalence of infectious diseases, which cannot be accounted for by known inequalities of exposure, must be explained by concomitant changes in human resistance or by changes in virulence of the specific microörganisms. And while such explanations belong at present to the realm of speculation, diphtheria more than any other human disease offers opportunity for study of certain fundamental facts necessary for any rational theory. Reasonably adequate statistics of morbidity and mortality are available; the frequency of infection can be determined rapidly and economically for large population groups; and at least the minimal frequency of immune persons may be determined by the application of the Schick test. Other desirable measures are lacking both as regards the characteristics of the microörganism and the detection of immunity other than antitoxic. There is, however, a paucity of data respecting those facts which are readily gathered, and it is especially regrettable that so little is known regarding the frequency of carriers and the progress of natural immunization during periods of low prevalence.

For these reasons efforts were made in 1937–1938, and were repeated in 1938–1939, to determine as exactly as possible the frequency of diphtheria carriers among school children of the Cleveland public schools. In 1938–1939, a large number of school children were also Schick tested. The technical procedures in both studies, including methods of isolation and identification of *Corynebacterium diphtheriae* and the use of a standard toxin in Schick testing, were those approved by the Diphtheria Sub-committee of the Committee on Administrative Practice. It is hoped that the methods and results of each of these surveys may be published later in detail. The present report is an attempt to synthesize data relating to infection, morbidity and immunity. Two important questions will be discussed:

1. The current quantitative relationship between carrier infection and clinical diphtheria.
2. The incidence of carrier infection in relation to the rate of acquirement of antitoxic immunity.

1. THE CURRENT RATIO OF INFECTION TO DISEASE

One of the points of greatest interest in diphtheria is the quantitative relationship which exists between the number of demonstrable carriers and the number of cases of clinical diphtheria. During the two academic years included in the survey, 4,720 children of ages from 5 to 14 years, inclusive, were examined bacteriologically, nose and throat swabs being made from each child. The children were so selected that those examined in each month may be considered to be fairly representative of the school population. In the year 1937–1938, the period included the months of October to May, inclusive, and, in the following year, the months of November to May, inclusive. Approximately the same results were found in the corresponding months of each year. The highest incidence was in November, and no carriers were found among 1,695 children examined in the months of March, April and May. The results for those months in which carriers were discovered are shown in Table 1.

TABLE 1

Results of Bacteriological Examination of White School Children in Cleveland, Aged 5–14 Years, Inclusive, for the Months in Which Diphtheria Carriers Were Found, 1937–1938 and 1938–1939, Combined

Month	*No. Examined*	*Carriers Found*	
		No.	*Per cent*
October	375	2	0.53
November	882	10	1.13
December	399	3	0.75
January	692	1	....
February	677	1	....
Total	3,025	17	0.56

The percentages given in Table 1 indicate only the proportions of children who were demonstrated to be harboring toxigenic *Corynebacterium diphtheriae* at a given time. For comparison with the incidence of diphtheria it is necessary to estimate the number infected each day, each week, or each month. In making such a calculation certain assumptions are necessary. It must be assumed that infection occurs more or less at random in the population concerned. Also some estimate must be made of the probable duration of the carrier state, as this is not known for casual carriers with any exactness. In making a similar calculation Frost [1] assumed that the observations of Hartley and Martin [2] on convalescent carriers might be applied, and our calculations have been made on the same basis. From the equation for the curve representing the disappearance of bacilli, as given by these authors, the proportion of remaining carriers becoming negative in each 24 hour period was found to be 5.16 per cent. Hence to maintain any given rate of infection an equal proportion must become carriers each day. Thus in any month the total number of carriers would be approximately 1½ times those demonstrable on a single day.*

These calculations were made for each month in which carriers were found, that is, from October to March. The estimated numbers of children becoming carriers in each month and the average number per month for the 5 month period are shown in Table 2, with the corresponding average diphtheria incidence for children of the same age group.

TABLE 2

Comparison between Estimates of Carrier Infections and the Incidence of Diphtheria, for Cleveland Children, Aged 5 to 14 Years, 1937–1939

Period Included (Averages of 2 Years)	Incidence per 100,000		Ratio Carrier Incidence: Case Incidence
	Carrier Infections	Clinical Diphtheria *	
October	820	0.35	.....
November	1,730	2.43	712:1
December	1,100	2.43	453:1
January	210	2.43	.....
February	210	0.35	.....
Monthly average	890	1.67	533:1

* Estimated population Jan. 1, 1938, 144,000.

The results of this calculation are very remarkable. Apparently more than 500 carrier infections occurred, on the average, in each month, to each attack of diphtheria. This is a very different result from that obtained by Frost,[1] in his study of the Baltimore data for 1921–1922, who estimated that there were about 47 carriers to each case of diphtheria, for children aged 5 to 14 years. For comparison, our tabulations have been arranged in the same manner as those of Frost. Even if it were considered that the methods of carrier detection are twice as efficient today as in the earlier period, the present estimates would indicate 4 or 5 times as

* The formula for the data of Hartley and Martin, as derived by Greenwood, is $\log Y = 2.6002 - 0.0218\ X$. If y1 and y2, respectively, represent the numbers of persons carrying *C. diphtheria* on 2 successive days, then $\log y1/y2 = 0.0218$, and $y1/y2 = 1.0516$.

From our data for October, therefore, to maintain a carrier rate of .53 per cent through the month, the percentages of the population becoming carriers each day would be $.0053 \times .0516$, or .0002735. This is p, the daily infection rate, and q, or the chance of not being infected in a day, is .9997265. The chance of being infected at least once in the month is $1 - q^{30}$, or .0082, which is approximately 1½ times the observed rate. Similar calculations were made for each month. The mean monthly carrier incidence (Table 2) is based on $p = .0056 \times .0516$.

many carriers per case as were observed in Baltimore.

Unfortunately, no studies of carrier infection or of diphtheria immunity have been made previously on a representative sample of Cleveland school children. In 1921–1922, the reported incidence of diphtheria was about the same as in Baltimore. It is almost inconceivable that, had a carrier survey been made at that time, it would have revealed an infection rate of only one-fourth or one-fifth that observed in Baltimore. The conclusion seems justifiable therefore that a great increase in the ratio of carrier infections to clinical attacks has occurred in Cleveland.

Since clinical diphtheria occurs almost exclusively in Schick-positive individuals, a more enlightening comparison would embrace only this class. This is especially desirable if ratios of the present day are to be compared with those of a period in which active immunization was not so extensively practised. There are few observations on the relative liability of Schick-positive and Schick-negative children to infection, and the assumption of a more or less random distribution of carriers must be retained in making such calculation. Carrido-Morales and Costa-Mandry [3] found a somewhat higher frequency of carriers of toxigenic *Corynebacterium diphtheriae* in Schick-positives than in Schick-negatives, but the numbers of children included were relatively small. In the Cleveland studies direct observations were not made on this phase as it was considered essential that the carrier study should include as nearly as possible a representative sample of school children and, as noted below, this was not possible in the Schick testing. All Schick tested children might have been examined bacteriologically but resources and facilities did not permit undertaking this additional task. On checking the files for both series it was found that 4 of 17 carriers had been Schick tested. Three, whose discovery antedated Schick testing by about 1 year, were negative. The fourth had been tested on October 19, 1938, and found positive; on December 6, that is, 1½ months later, he was found to be a carrier.

More than 7,000 children were Schick tested in October and November, 1938, with the standard toxin. Since parental consent was necessary, and since it is probable that a larger percentage of parents of children previously immunized consented than of others, it is probable that the sample is heavily overweighted with children who have received active immunization. Of children aged 5 to 14 years, 35.6 per cent were found to be Schick-positive, a figure which is more likely to be lower than higher than would be found in a representative sample.

If the comparison of carriers to cases be restricted to the class of Schick-positives, on the assumptions mentioned, the average monthly attack rate is raised from 1.67 per 100,000 to 4.7 and the ratio consequently reduced to approximately 190:1 That is, among Schick-positives of ages from 5 to 14 years, nearly 200 infections are estimated for each case of diphtheria.

For a section of Baltimore, Frost, Frobisher, Van Volkenburgh, and Levin [4] have compared the carrier incidence in 1921–1922 and in 1934–1936 with the estimated annual attack rates for Schick-positive children in approximately the same periods. The incidence of carriers in the later period was found to be 44 per cent of the incidence in the earlier, but the estimated attack rate for Schick-positives in 1933–1936 was only 15 per cent of that for 1921–1924. Apparently, therefore, in 1933–1936, a given number of infections of Schick-positive children, aged 5–14, produced only about one-third as many cases of diphtheria as in 1921–1924.

It is probable that the methods of

isolation used in the present study reveal at least 50 per cent more carriers than the methods used in Baltimore in the two surveys mentioned (Frobisher and Van Volkenburgh [5]). If the proportions found infected in Baltimore be increased to this extent, a rough comparison may be made between the first and second Baltimore surveys and that in Cleveland with respect to the ratio of infection to disease in Schick-positive children.

Following the same procedure as that used by Frost, *et al.*[4] it was estimated that, in Cleveland in 1937–1939, a given number of infections of Schick-positive children produced only about one-fourth as many cases as in Baltimore in 1921–1924, and about three-fourths as many as in Baltimore in 1933–1936. In making these approximations, the carrier percentages for children aged 5–14 years were assumed to be as follows: Baltimore, 1921–1922, 3.66; Baltimore, 1933–1936, 1.62; and Cleveland, 1937–1939, 0.56. The average annual attack rates per 100,000 for Schick-positives of the same ages were, respectively, 1,383, 204, and 56.

2. FREQUENCY OF INFECTION IN RELATION TO THE RATE OF NATURAL IMMUNIZATION

Some difficulty was experienced in determining the present status of antitoxic immunity in children not previously immunized. Names and addresses of all children tested were checked against the records of the Board of Education and of the Division of Health to learn whether or not toxin-antitoxin, toxoid, or alum precipitated toxoid had been previously administered. More than 2,000 homes were then visited to learn of possible unrecorded immunization, performed either by private physicians in Cleveland or elsewhere, or by health departments in places of former residence. Omitting all for whom the history is still unknown, and also omitting all who are known to have had a Schick test without subsequent immunization, there remain 982 children, the results of whose tests are given in Table 3.

TABLE 3

Results of Schick Test with Standard Toxin for Cleveland School Children Not Previously Immunized Nor Schick Tested, October and November, 1938

Age	*Total Tested*	*Positive*	*Per cent Positive*
5 years	164	144	87.8
6 "	137	115	83.9
7 "	49	41	83.6
8 "	40	34	85.0
9 "	90	71	78.8
10 "	96	73	76.0
11 "	115	89	77.3
12 "	142	103	72.5
13 "	84 *	57	67.8
14 "	43	28	65.1
15 "	22	14	63.6
Total	982	769	78.3

* One additional child had a doubtful reaction.

It appears that only about one-third of the children of the Cleveland public schools, not previously immunized, have acquired a negative Schick test before the age of 15 years. Comparison of these results with those of an earlier period is not possible; at least we have been unable to find any records of previous Schick testing of non-immunized children which permit a valid comparison. It is considered, however, from such information as is available, that the proportion giving a negative test at this age was higher 10 to 15 years ago, and such a conclusion is in conformity with the findings in other large cities at that time.

The most interesting question is perhaps not the absolute status of the children but the rate at which antitoxic immunization has been occurring in recent years. From the figures of Table 3, 22.7 per cent of children acquired immunity between the ages of 5 and 14 years, an annual increment of 2.52 per cent. This is much lower than the corresponding average annual increment as given in the Baltimore statistics for 1921–1924, which was 4.24 per cent.[6]

The incidence of carriers of toxigenic

diphtheria bacilli in Baltimore, in the winter of 1921–1922, was found to be 2.44 per cent for children of these ages. As above noted, this figure should be raised to about 3.66 per cent, at least, for comparison with the Cleveland findings in 1937–1939 (0.56 per cent).

If there is a direct relationship between the incidence of carrier infection and the rate of increase of natural antitoxic immunity, the annual increment of Schick-negatives would be expected to be much lower than 2.52 per cent, on the basis of the Baltimore studies of 1921–1924. This may be shown in the following manner.

Let X = expected proportion becoming negative annually

Then 2.44 : 0.56 : : 4.24 : X. X = 0.97 per cent

Or, increasing the percentages of carriers found in Baltimore by 50 per cent:

3.66 : 0.56 : : 4.24 : X. X = 0.65 per cent

The results of these comparisons may be interpreted as indicating that any stated number of infections in Cleveland in 1937–1939 produced 2.6 times (i.e., $\frac{2.52}{0.97}$) as many immunizations as in Baltimore in 1921–1924. The ratio is even higher in the second calculation.

This may also be demonstrated by a somewhat different method. It is not known whether there occurs any significant variation in the ratio of carriers to cases at different seasons. Assuming that the ratio does not vary significantly, Frost estimated that the annual incidence of carriers among children of from 5 to 14 years was approximately 25 per cent (2,538 per 10,000), or 47 times the annual morbidity rate. Applying the same method to the Cleveland statistics, the proportion of children of these ages who became carriers in each of the years under consideration would be 10.7 per cent, this being 533 times the average morbidity rate for the years 1937 and 1938 (20 per 100,000).

From these estimates of carrier prevalence and from the average annual increment in Schick-negatives, an estimate may be made of the number of carrier infections necessary, on the average, to produce sufficient antitoxin to give a negative Schick test. These ratios, for Baltimore and for Cleveland, are given in Table 4.

Although too much weight should not be placed on comparisons which are admittedly based on inadequate data, it is of interest that the number of infections required to produce a negative Schick test in Cleveland as computed by both these methods, was at least not greater and was probably much less than in Baltimore. If this conclusion could be substantiated, it would mean that, in ability to stimulate antitoxin production, *Corynebacterium diphtheriae* has been just as effective in recent years as in a period of much higher prevalence and mortality. If there has been a loss of pathogenicity there has apparently been no associated loss of antigenicity. This conclusion gains some support from the fact that the strains isolated from carriers in recent times are, as a rule, good producers of toxin.

TABLE 4

Estimated Number of Carrier Infections Necessary to Produce a Negative Schick Test, for Children Aged 5–14 Years

Locality and Period	*Annual Rates per 100,000*		*Ratio*
	Carrier Incidence	*Increment of Schick-negatives*	*Carriers to New Negatives*
Baltimore, 1921–1923 *	38,070	4,240	9.0:1
Baltimore, 1921–1923 †	25,380	4,240	6.0:1
Cleveland, 1937–1939	10,660	2,520	4.2:1

* Based on 1½ times reported carrier incidence

† Based on reported carrier incidence

SUMMARY AND DISCUSSION

The decline in diphtheria mortality in Cleveland which commenced about 60 years ago was greatly accelerated after 1927, with the result that the city is now experiencing the lowest death rates in its recorded history. Concerning morbidity, the older statistics are not so reliable; since 1927, there has been a remarkable reduction, corresponding closely to that in mortality.

The explanation of the recent acceleration in the decline of both mortality and morbidity is by no means obvious. Although it corresponds roughly with the more extensive practice of active immunization, both death rates and morbidity rates have fallen more rapidly and to a much lower figure than would be expected from the estimated proportion of the population which was immunized, unless there is a very substantial indirect result from immunization. The decline, however, has not been peculiar to Cleveland but has occurred in many other areas in this country and in Europe. Viewed from the broader angle it is more likely that causes other than immunization have been a significant factor.

A study of the frequency of carriers of toxigenic *Corynebacterium diphtheriae* was carried out in Cleveland during the academic years 1937–1938 and 1938–1939. This study revealed a carrier incidence of 0.56 per cent for children of ages from 5 to 14 years, for the months October to February, inclusive. No carriers were discovered in March, April, or May.

Application of the Schick test to children of the same ages, in October and November, 1938, revealed an average incidence of negatives of 36.5 per cent. It is probable that the sample tested included a higher proportion of immunized children than is true of the general population of the same ages.

For the 5 months in which carriers were found, the estimated ratio of carrier infections to clinical attacks is 533:1. This is remarkably high in comparison with the ratio for Baltimore for 1921–1922, which Frost estimated to be about 47:1 for children of the same ages. Even if present bacteriological methods are twice as efficient as those of that time, it appears that there were in Cleveland in 1937–1939, at least 4 or 5 times as many infections per case as in Baltimore in 1921–1922.

In comparing the present day with a period in which active immunization was little practised, it is more enlightening to consider only the Schick-positive population. Assuming that carrier infection is as frequent in this class as in negatives and also that all or almost all clinical attacks occur among Schick-positive individuals, the ratio of infection to attacks in this class is estimated as about 190:1. Estimates have been made of the relative number of infections of Schick-positive children which have resulted in disease in Cleveland in 1937–1939, as compared with two periods in Baltimore for which similar statistics were available. The results of these comparisons indicate that any given number of infections of Schick-positive children, aged 5 to 14 years, in Cleveland, resulted in only one-fourth as many clinical attacks as in Baltimore in 1921–1924, and in about three-fourths as many attacks as resulted in Baltimore in 1933–1936.

Examination of the recent diphtheria experience of Baltimore shows close agreement with that of Cleveland. In the absence of any representative statistics for Cleveland relating to carrier infection and Schick testing for an earlier period, caution must be used in interpretation. It is, however, probable that there has been a considerable increase in the ratio of infection to disease in Schick-positive children in Cleveland. Lacking further evidence we cannot do better than to quote the conclusions reached by Frost, *et al.*[4] following an

illuminating comparison of the periods 1921–1924 and 1933–1936 in Baltimore:

> One of the three changes tending to reduce morbidity, the decreased proportion of Schick-positives, may reasonably be attributed directly and fully to artificial immunization. The other two more important factors concerned in the reduction of morbidity, namely, diminished infection-frequency and smaller ratio of cases to infections, are not related in any obvious way to artificial immunization. Nor does it seem probable that they are, to any considerable extent, the result of environmental changes which would tend to reduce the opportunities for transfer of infection from person to person. It seems more reasonable to regard them as the result of natural forces operating either to increase some factor of human resistance not indicated by the Schick test, or to produce some change in the quality of the diphtheria bacillus, tending to reduce both its infectivity and its pathogenicity. Or, it may be that both human resistance and bacteriological quality have changed, and perhaps not independently, each reacting on the other.

There is another interesting feature. From the results of the Schick test on Cleveland children who have never received toxin-antitoxin, toxoid, or alum precipitated toxoid, the annual increment of Schick-negatives in recent years was found to average 2.52 per cent per year for children aged 5–14 years. Calculations are given, which must be considered as only rough approximations, showing the numerical relationship of carrier infections to immunization as evidenced by negative Schick tests, the ratio being about 4 or 5 to 1. Applying the same arithmetical method to the Baltimore statistics for 1921–1923, it is found that the number of infections for each new negative was certainly not less and apparently considerably higher. The conclusion is reached, therefore, and it should be supported by further studies, that if there has been a loss in pathogenicity on the part of *Corynebacterium diphtheriae*, there has been no associated loss in antigenicity.

It is difficult to find unequivocal data relating to the maintenance of immunizing qualities, associated with loss of virulence, in the field of bacterial diseases. For the viruses, two observations may be mentioned, one old and one of recent date. There is little doubt that the virus of variola, after passage through the calf, is almost as effective an antigen as formerly, although its capacity to produce disease in man is greatly diminished. Findlay,[7] and Lloyd, Theiler and Ricci [8] have reported similar findings with the virus of yellow fever, with resultant preparation and extensive use of yellow fever vaccine. The latter workers, after prolonged cultivation in chick embryo tissue from which the central nervous system had been removed, found the virus to have greatly diminished neurotropism and viscerotropism but to have retained its antigenic properties. In each of these instances, change in the virus has been accomplished only after prolonged growth in the tissues of another species.

In conclusion, a plea is made for continuation and intensification of studies on diphtheria, both in the field and in the laboratory. With the great decline in prevalence and mortality there may be a corresponding decline in interest on the part of health officers and epidemiologists. This would be most unfortunate as many of the problems remain unsolved, some of which appear to be common to a considerable number of infectious diseases.

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Schick Tests and Carrier Surveys in White School Children, Alabama, 1937-1938

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THE diphtheria picture as regards incidence, susceptibility, and carrier status is not uniform throughout the United States. For several years the number of cases of diphtheria reported has been greatest in the southern states, and it is not felt that this excess morbidity has been due primarily to lack of immunization, but rather to other factors concerned in the spread. Alabama, as a representative southern state, has had an annual average of 1,172 cases of diphtheria reported during the 5 years, 1934–1938, or an annual rate of 4.1 per 10,000 population.

The present study was undertaken to determine two factors concerned in the spread of this disease: (1) the immunity status of white school children as measured by the Schick test, (2) the prevalence of carriers of virulent diphtheria organisms in this same population. White school children of grammar school age, 5–14, were selected for study, and geographical areas typical of the state were used in the study.

The Schick testing was conducted by the author throughout, using standard toxin prepared by the Connaught Laboratories, with heated toxin used as a control. The tests were read on the 7th day and interpreted as positive, negative, or pseudo reactions. The culturing was done by taking one swab from the nose and one from the throat and planting both immediately on a single tube of Loeffler's medium. These cultures were returned to the laboratory the same day and after incubation over night were transferred to cystine-tellurite-blood agar plates. After 48 hours' incubation on the tellurite media the cultures were examined and from 3 to 6 diphtheria-like colonies were picked from each plate and transferred again to Loeffler's medium. After 18 to 24 hours' incubation of these Loeffler's slants, smears were made for microscopic examination and all cultures showing diphtheria-like organisms were transplanted to dextrose and saccharose broths. Those reacting on sugars as *Corynebacterium diphtheriae* were transferred again to broth cultures for virulence tests. Rabbits were used for the virulence tests following Fraser's technic.

All cultures showing typical morphology and giving typical reactions on dextrose and saccharose, whether virulent or non-virulent, were sent to Dr. Martin Frobisher at Baltimore for confirmation. The figures used are based on his findings.

The study was carried out during two school years, October, 1937, to February, 1938, and October, 1938, to December, 1938. In the first year's work the Schick testing was done on school children in Perry and Conecuh Counties and the rural schools of Mont-

gomery County. The culturing was done on schools of Lee, Chilton, and Marshall Counties, with a sample from the suburban schools of Birmingham. The group examined in the fall of 1938 were in Randolph and Shelby Counties and the same individuals were used for both tests. Histories as to previous immunization were obtained and were checked through the records of the schools and the county health departments. There are some possible errors in listing children as not previously immunized who may have had an immunizing agent, but the numbers are not large.

Tables 1 to 4 show the results.

TABLE 1

Schick Tests on White School Children, Alabama, 1937–1938

	No History of Previous Immunization			*History of Previous Immunization*		
Age	*Schick-positive*	*Schick-negative*	*Per cent Schick-negative*	*Schick-positive*	*Schick-negative*	*Per cent Schick-negative*
6	61	195	76.1	10	121	92.4
7	42	280	87.0	12	132	91.7
8	41	321	88.7	10	126	92.6
9	48	323	87.1	5	130	96.3
10	34	335	90.8	2	126	98.4
11	23	309	93.1	7	120	94.5
12	17	240	93.4	1	60	98.4
13	5	118	95.9	1	35	97.2
14	4	68	94.4	0	6	100.0
15	2	44	95.7	0	8	100.0
Total	277	2,233	89.0	48	864	94.7

TABLE 2

Results of Bacteriological Examinations of Nose and Throat Cultures for Corynebacterium Diphtheriae, Alabama, 1937–1938

	Number Examined	*Number Negative*	*Number Avirulent*	*Per cent Avirulent*	*Number Virulent*	*Per cent Virulent*
Oct. 1937–Jan. 1938	3,499	3,404	80	2.29	15	0.43
Oct. 1938–Dec. 1938	1,800	1,692	77	4.27	31	1.72
Totals	5,299	5,096	157	2.96	46	0.87

TABLE 3

Results of Bacteriological Examinations of Nose and Throat Cultures for Corynebacterium Diphtheriae According to Schick Status, Alabama, 1938

Schick	*Number Examined*	*Number Negative*	*Per cent Negative*	*Number Avirulent*	*Per cent Avirulent*	*Number Virulent*	*Per cent Virulent*
Negative	1,448	1,359	93.8	66	4.5	23	1.6
Positive	174	167	96.0	5	2.9	2	1.1
Doubtful	36	35	97.2	0	0.0	1	2.8
Absent for Reading	142	131	92.2	6	4.2	5	3.5
Totals	1,800	1,692	94.0	77	4.3	31	1.7

TABLE 4

Results of Bacteriological Examinations of Nose and Throat Cultures for Corynebacterium Diphtheriae According to Age, Alabama, 1937–1938

Age	*Number Examined*	*Number Negative*	*Per cent Negative*	*Number Avirulent*	*Per cent Avirulent*	*Number Virulent*	*Per cent Virulent*
0– 4	23	23	100.0	0	0	0	0
5– 9	2,879	2,753	95.6	93	3.2	33	1.1
10–14	2,349	2,273	96.8	64	2.7	12	0.5
15+	48	47	97.9	0	0.0	1	2.1
Totals	5,299	5,096	96.17	157	2.96	46	0.87

The striking observation regarding Schick testing is the high percentage of immunes regardless of whether the child had received an artificial immunizing agent or not. From age 7 and above, few Schick-positive children were seen. By the time a child had been in school a year, natural immunity had developed in a very high percentage. This would seem to indicate that these children are being exposed to diphtheria organisms.

The tables on the results of nose and throat cultures reveal a rather high carrier rate, particularly in the group examined in the fall of 1938. These figures were obtained from a single nose and throat culture and represent minimum findings. Repeated culturing would undoubtedly raise the number of carriers of virulent organisms found. It is interesting to note that 2 children with positive Schick tests were harboring virulent organisms without any evidence of illness. The age group 5–9 showed twice as high a carrier rate as the older children, 10–14.

SUMMARY

Eighty-nine per cent of 2,510 white school children without a history of previous immunization were Schick-negative.

Ninety-four and seven-tenths per cent of 912 white school children with a history of artificial immunization were Schick-negative.

Forty-six carriers of virulent diphtheria, or 0.87 per cent, were isolated in the examination of 5,299 nose and throat cultures and an additional 157 carriers of non-virulent diphtheria organisms, or 2.96 per cent, were found in the same group.

Cultures taken during October to December, 1938, revealed 1.7 per cent virulent carriers and 4.3 per cent avirulent carriers from 1,800 examinations.

Strains of C. Diphtheriae in Various Parts of the United States

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MANY public health administrators look upon the control of diphtheria as a problem which has been solved. Effective therapeutic antitoxin to prevent deaths, and satisfactory immunization procedures to prevent cases, are available at costs within the reach of all. The disease has been rapidly declining, and has even disappeared from many communities for several years. It is often assumed that if present efforts are maintained, the future may be faced with confidence.

With this view there can, in general, be no serious disagreement, but it is entirely possible that the future is not quite so assured, at least in some parts of the world, as it seems to be. Diphtheria epidemics of a fulminating nature which seem to progress regardless of immunity, as measured and controlled at present, are not uncommon. The famous outbreak at Leeds,[9] in which strains of diphtheria bacilli possessed of certain definite cultural characters (and designated as *Corynebacterium diphtheriae* gravis) were shown to be the inciting agent, is a case in point. There are numerous descriptions of other similar outbreaks in the literature due to the gravis and other types, and some of those reading this article have doubtless had personal experience with this sort of diphtheria outbreak. It is conceivable that the various types of diphtheria organisms responsible for these epidemics might spread more widely throughout the country and eventually create a situation of real gravity.

In view of these possibilities, the present study was undertaken for the purpose of collecting data concerning the distribution of different biological types of *Corynebacterium diphtheriae* and their fluctuations from year to year, and eventually ascertaining, if possible, their relation to diphtheria morbidity and mortality and the process of natural immunization.

The investigation was initiated in 1937, following several years of study of diphtheria morbidity and carrier rates in Baltimore,[1, 2] and determinations of the biological characteristics of the organisms isolated there. The investigations described in this report are a continuation of the foregoing, extended to various parts of the United States. Specifically, attempts were made, to determine the following points:

1. Are there any cultural or biological characteristics of *Corynebacterium diphtheriae* which can be correlated with special virulence for rodents or human beings?
2. Do biological differences exist between different strains of diphtheria bacilli obtained from different localities, and do these characters change from time to time?
3. What are the carrier rates with respect to both virulent and avirulent organisms and different cultural types in different places, and what is their relation to time, locality, and rates of natural immunization?
4. May changing trends in biological types

be so correlated with morbidity rates, natural immunity status, etc., as to be of value as guides in the administrative control of diphtheria?

METHODS

Since results obtained in various laboratories form a part of the basis of this report, every effort was made in the laboratories involved to maintain as high a degree of uniformity in all phases of the work as possible. The field and laboratory procedures initially adopted for the carrier surveys in Baltimore, and described elsewhere [1, 2] were followed rather closely. For details, the reader is referred to the literature cited. In addition to the pure cultures isolated at the local laboratories following this technic, some surveys were made by rubbing the nose and throat swabs on Loeffler slants in the field or local laboratory, incubating the slants there, and then shipping them by air express to Baltimore where the cultures were plated and pure cultures of *Corynebacterium diphtheriae* obtained. The latter method proved remarkably satisfactory and in only one or two instances was there any difficulty, usually occasioned by bad flying weather.

Every pure culture was studied, as heretofore, according to a uniform method by the writer only, or under his immediate supervision by Dr. Elizabeth Parsons. In this manner, the personal factor in the comparison of cultures has continued at a minimum throughout.

RESULTS

It is unusual to obtain a direct and unqualified answer from Nature except by such crude questionings as placing the hand on a hot stove. However, in the present instance, an apparently unqualified answer to the first of the questions in our list has been obtained. As seen in Table 1, by comparing the data in columns 1, 2, and 5, it is quite evident that no significant correlation exists between cultural characters *(as demonstrated by the methods described)* and virulence *(as demonstrated by guinea pig and rabbit tests)*. As judged by these methods, the "gravis" * type of organism (in the time and areas studied) is frequently avirulent. When virulent, it is frequently present in the absence of disease and when present in disease, the case is frequently mild.

The possibility should be emphasized, however, that under other circumstances, for example under natural conditions *(as opposed to laboratory cultures and rodent tests)*, a definite correlation may exist between cultural types and diphtheria epidemiology. Certain field data suggest that the prevalence of "gravis" types may be directly associated with increased morbidity. For instance, the gravis type of *Corynebacterium diphtheriae* is common and has been definitely on the increase (at least in the last year) in Virginia and Alabama but not in the North (Table 1, col. 2). The striking *prevalence* of gravis strains, and particularly the increasing prevalence of *virulent* gravis strains this year in Alabama (Table 3) seems significant in view of the low prevalence or entire absence of these organisms in the North; especially when it is borne in mind that death rates in the North as a whole have declined greatly in the past decade while those in the South have, in many places, decreased much less extensively and rapidly.[6]

Although many avirulent gravis strains have been found, the type may not always have been so mild or so

* As pointed out in a previous paper [3] the definition of "gravis" is almost as varied and manifold as the names of diphtheriologists. The term as used here corresponds as closely as possible under the circumstances to the original description of the Leeds workers. However, in this discussion, it refers to a group of cultural characters and has *no relation to virulence*. That is, organisms having all the cultural characters of *Corynebacterium diphtheriae* gravis may or may not be virulent *as tested in the laboratory* and many virulent and avirulent gravis strains have been isolated in the surveys at present under discussion. The same considerations apply to the term *Corynebacterium diphtheriae* mitis.

TABLE 1

Characteristics of Organisms Found in Various Places in 1937–1938 and 1938–1939 [1]

	Mitis and Mitis-like (1)		*Gravis and Gravis-like* (2)		*Virulent* (3)		*Dissociating* [3] (4)		*Total* [4] (5)	
	1937–1938	*1938–1939*	*1937–1938*	*1938–1939*	*1937–1938*	*1938–1939*	*1937–1938*	*1938–1939*	*1937–1938*	*1938–1939*
Alabama	66	37	10	45	18	28	19	60	90	104
Shelby	..	74	..	7	..	23	..	44	..	43
Randolph	..	10	..	72	..	31	..	72	..	61
Virginia	94	12	0	64	26	18	9	29	34	17
Cleveland	100	85	0	5 [2]	25	35	15	85	28	20
Michigan	91	79	0	0	27	18	45	89	11	19
Kingston	100	81	0	3.5 [2]	29	0	71	63	14	27
Ossining	..	76	..	0	..	12	..	88	..	17

[1] Figures give per cent of total cultures received
[2] Based on one culture only
[3] Dissociating (unstable) cultures
[4] Total cultures of C. diphtheriae received.

restricted in its habitat as we find it at present. It seems almost certain that some strains of *Corynebacterium diphtheriae* are susceptible, at times, of a tremendous exaltation of aggressiveness or dispersiveness. The enhancement of virulence does not seem to be manifested in the usual animal tests and may not always be accompanied by *gravis* cultural characters (starch fermentation, etc.), but it seems to occur most readily in strains possessing these characters. This enhancement of virulence seems to convert them into extraordinarily dangerous parasites not hampered by immunity as we ordinarily measure it. Such strains were involved in the Leeds outbreak and form the basis of the original description of the gravis type of diphtheria bacilli. Thus, while a high gravis carrier rate is obviously not in itself necessarily dangerous, if gravis strains are most susceptible of sudden great enhancements of virulence, their increasing prevalence in any community may constitute a potential menace.

As a possible illustration of the growth of such a menace in a population, we may consider some details of case-culture studies carried on as a supplement to these surveys. For example, in the Eastern Health District of Baltimore, the organisms isolated from clinical cases of diphtheria have for the past 6 years been predominantly of the mitis or mitis-like type; only 2 or 3 gravis-like strains having been encountered during that time. Diphtheria morbidity and mortality have been low. Similarly, in Rochester, N. Y., and Cleveland, Ohio, case cultures have been entirely mitis or mitis-like. In Virginia, on the contrary, an institutional outbreak in 1937–1938 consisted entirely of gravis-like cultures (7 cases studied). In that year, the carrier cultures in the general population were predominantly of the mitis-like type (94 per cent) (Table 1, col. 1). This year, however, we find that 17 per cent of case cultures (not institutional cases) and *64 per cent of carrier cultures* are of the gravis-like type (Table 1, col. 2). One wonders whether Virginia is about to be visited by diphtheria of an enhanced degree of malignancy or dispersiveness. Morbidity data show a definite increase for 1938–1939 in some sections.

Turning from these interesting speculations to the second of our listed questions, we again find a clear-cut answer. It is quite evident, as shown in Table 1, that marked differences do, indeed, exist between diphtheria organisms found in different localities and, more interesting still, that they change radically from year to year. Attention is called espe-

cially to changes in ratio of gravis to mitis types (cols. 1 and 2), ratio of virulent to avirulent cultures (col. 5), and fluctuations in the stability of the flora as measured by the number of "dissociating" strains. The latter are strains which, when plated out on McLeod's medium, exhibit several different colony types, the variant colonies in subculture often having very different biological characters from the parent strains (although practically always resembling them in virulence or avirulence). Cultures from one locality may be distinguished by the fact that very few "dissociate" in this manner, those from another source being very prone to vary or "dissociate" and constituting an "unstable diphtheria flora." So well defined are these and other differences in organisms from different parts of the country that it was often found possible for the experienced worker to state the source of a group of cultures from the information gained by a study of their properties. For example, it was quite evident to the laboratory workers in Baltimore when the survey in Alabama changed from Shelby to Randolph County although they had no information concerning it.

Aside from the purely bacteriological interest attached to these findings, which will be discussed in a later paper, they may have a fundamental epidemiological significance. The study of so apparently obscure a point, for example, as the dissociation of cultures may be of value. Thus, it is noted that there is a marked increase in the number of "dissociating strains" in Alabama, Virginia, and Michigan in 1939 over 1938. Correlated with this in Alabama and Virginia we find a tendency to change in the direction of increased numbers of gravis and gravis-like cultures in 1939 over 1938, and a trend in Michigan away from the mitis type toward the gravis by way of increased numbers of the indeterminate or intermediate type (not shown in the tables). In Ohio, and Kingston, N. Y., a similar tendency is shown although the figures for the latter places are too small to be of any immediate significance. In addition to this, considerable changes in the ratio of virulent to avirulent cultures (or vice versa) are seen from year to year in nearly all of the areas studied. It is possible that investigations of the nature and extent of the "dissociations" (or instability) occurring in the carrier flora, as well as the cultural types present, may furnish a guide or warning to the health officer as to future changes in virulence or dispersiveness. One phenomenon may precede another by a year or more. It has already been indicated that the measurement of gravis carrier rates in a community could serve as a guide to the accumulation of a flora which, there is reason to believe, may be peculiarly susceptible to enhancement of virulence: a potential menace.

Again turning to our list of questions, we find with respect to the third, that, as seen in Table 2, markedly different carrier rates were found in different places (col. 1), not only at a given time but at different times in a given place.

Considerable differences in rates of natural immunization were also found (col. 4).

These various rates are of especial interest in respect to the number of *avirulent* organisms isolated during the carrier surveys (col. 2). A rôle for these avirulent organisms in the epidemiology of diphtheria has long been sought, but no satisfactory place for them has been found so far. Doull [3] showed that familial exposure of susceptible children to carriers of avirulent organisms resulted in a higher attack rate among the exposed than occurred in non-exposed (10 as compared with 3 or 1). Chason [4] showed that a high rate of natural immunization (92 per cent at 10 years of

TABLE 2

Comparison of Carrier Rates, Natural Immunity and Types of Organisms in Various Places in 1937–1938 and 1938–1939

	Children Found to Be Virulent Carriers (1)		*Children Found to Be Avirulent Carriers* (2)		*Per cent of Cultures Avirulent* (3)		*Naturally Immune* (4)		*Morbidity Rate* (5)	
Locality	*1937–1938*	*1938–1939*	*1937–1938*	*1938–1939*	*1937–1938*	*1938–1939*	*1937–1938*	*1938–1939*	*1937–1938*	*1938–1939*
Alabama	0.45	1.5	2.1	3.9	82	72	89 [2]	85 [2]	4.0 [3]	7.0 [4]
Shelby	....	1.0	...	3.3	..	77	..	95 [2]	7.5	5.4
Randolph	....	2.1	...	4.7	..	69	..	78 [2]	3.0	8.6
Virginia	0.5	0.4	1.2	0.9	73.6	82.3	53 [5]	60 [6]	66.4 [5]	16.0 [6]
Ohio	0.24	0.33	0.72	0.95	75	65	..	17	7.4	7.8
Michigan	0.21	0.10	0.21	0.18	73	82	20 [6]	20 [1, 6]	0.05 [1]	0.05 [1]
Kingston	0.28	0.00	0.67	1.55	71.4	100	33 [2]	18 [1, 2]	3.5	3.5
Ossining	....	0.18	....	0.15	....	88	..	32 [2]	7.1	41.5

1. Estimated
2. Age groups 0–1.
3. Average of rates for Lee, Chilton, and Marshall counties cultured in 1937
4. Average of rates for Shelby and Randolph counties cultured in 1938
5. Prince George, Hanover, and Pulaski counties and Norfolk city cultured in 1937–1938.
6. Arlington county cultured in 1938–1939
7. Figures are for the calendar years 1937 and 1938; not 1937–1938 and 1938–1939
8. Figures derived for the whole study 1936–1937. Ninety-one per cent of the children were under 10.

age) existed in parts of rural Alabama; yet it was found that a great majority (5.6:1) of the organisms prevalent in nearby parts of rural Alabama were avirulent. Doull, *et al.*, showed likewise that a large percentage of persons (about 80 per cent) 6 months to 15 years of age in Rio de Janeiro were negative to the Schick test, yet artificial immunization is not carried out routinely there, and clinical diphtheria is a rarity. Unfortunately, we have no applicable diphtheria carrier rates, virulent or avirulent, for Rio de Janeiro.

In the present study, although the data on natural immunity are incomplete, some suggestive relationships seem to have been brought to light. For example, it was shown last year, and it is amply confirmed this year, that there are definitely higher virulent carrier rates in the South than in the North, at least as illustrated by New York and Alabama. Inequality is also found, but to a greater degree, in *avirulent* carrier rates and, in a general way, in natural immunity statuses. In one community (Kingston, N. Y.), in 1938–1939, no virulent organisms were found in a survey of over 1,700 children; a virulent carrier rate of 0.0. Yet among children under 10 the natural immunity rate (i.e., per cent of children found Schick-negative and who gave no history of active immunization, natural or artificial) is estimated at about 18 per cent on the basis of previous figures. Curiously enough, the *avirulent* carrier rate was 1.55. The suggestion is obvious that, even when all, or nearly all, virulent strains are removed from a community a certain minimal rate of natural immunization may be maintained by the so-called avirulent flora present in that community. Some of the natural immunity now present may possibly result from infections which occurred at a time previous to the present study. However, for the last decade, the morbidity rate in Kingston has been very little higher than it is now.

In Alabama we find an avirulent carrier rate of nearly 4 per cent for the entire survey and nearly 5 per cent in Randolph County. Of the rural children under 10, 80 to 95 per cent are naturally immune. Morbidity rates are considerably higher than in Kingston, however, and so are virulent carrier rates. The question may be raised,

nevertheless, whether these are sufficient to account for the observed natural immunity. Are the organisms which are now regarded as avirulent (on the basis of guinea pig and rabbit tests) wholly avirulent for man? May not some of them possess some low degrees of virulence not detected by the usual tests? May the supposedly avirulent (or very slightly virulent) organism constitute a "silent" immunizing mechanism, less active perhaps than fully virulent organisms, but still active? Even though wholly avirulent may they not, in their living state and natural host, contain a more or less efficient immunogen (for human beings) independent of any demonstrable toxigenic properties? No answer to these queries is available at the present time, but the possible basic importance of the "avirulent" organisms in diphtheria epidemiology suggests itself more and more strongly as the problem is investigated.

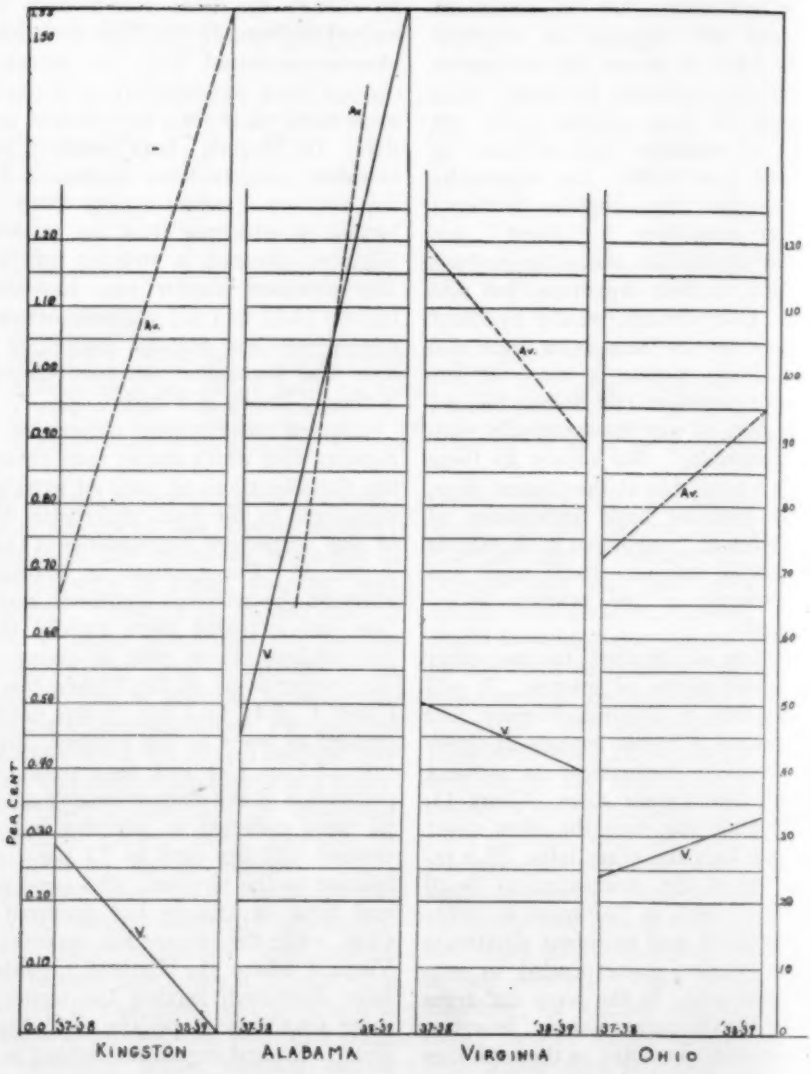
Attention is directed to one other point which seems of interest. It will be noted that in Alabama, Virginia, and Ohio there is a certain amount of agreement between fluctuations in virulent and avirulent carrier rates (Chart 1), in that when one rises the other rises; when one falls the other falls. This reminds one of the observation of Doull and Fales [7] that, in Baltimore in 1922–1923, virulent and avirulent diphtheria bacillus carriers corresponded in seasonal variations. In the years and areas covered by the present study, however, dissimilarities are noted in the rapidities with which the two kinds of organisms vary in prevalence. For example, in Chart 1 * it is seen that, in Alabama, both virulent and avirulent carrier rates increased between the surveys of 1937 and 1938 at virtually the same rapidities, these being indicated by the slope of the lines in Chart 1 (had there been no change the lines would have remained horizontal). In Ohio, both have likewise increased, but the avirulent carriers have increased at a distinctly more rapid pace than the virulent carriers. In Virginia, both virulent and avirulent carriers have decreased, but the avirulent carriers appear more reluctant to withdraw than the virulent. Kingston presents a striking contrast. The avirulent carrier rate has risen rapidly (0.67 to 1.55) while the virulent carrier rate has dropped from 0.28 to 0.0. The discrepancy between the two is clearly shown in Chart 1.

Coupled with these differences in rapidity with which carrier rates change, are the alterations in ratio of avirulent organisms to the total diphtheria flora of the respective communities (Table 2, col. 3). For example, in Alabama, although the avirulent diphtheria carrier rate has increased more rapidly than the virulent carrier rate, as shown by the steeper slope of the broken line in Chart 1 (0.45 to 1.55), it has not increased as *much* as the virulent carrier rate (2.1 to 3.9) and, as a result, the proportion of avirulent organisms among all those collected in Alabama has decreased (82 per cent to 72 per cent) relative to the virulent. The same general type of change has occurred in Ohio, while the reverse has occurred in Virginia where the virulent organisms have decreased, leaving the seemingly more tenacious or prolific or "dispersive" avirulent organisms behind in an increased proportion of the total.

One hesitates to suggest an interpretation of these observations, based as they are on a number of relatively small figures and on surveys made in not exactly identical seasons. One hypothesis suggests itself if we momentarily assume as a fact what Doull suggested in 1930 as a possibility, that "avirulent bacilli are at times the ancestors or descendants

* In this chart, it is not intended to show trends, but merely to compare rates of change by the slopes of the lines connecting the data for 2 successive surveys.

CHART 1—Virulent Carrier Rates and Avirulent Carrier Rates in Four Localities in Two Successive Years



of virulent organisms." One might then expect that they would vary rather closely in parallel. However, it appears that, for some reason, the factors inducing virulent bacilli to produce avirulent progeny acted slightly or not at all in some areas (Ohio and Alabama) but very vigorously in others (Kingston, N. Y., and Virginia).

It is particularly puzzling to note, in this connection, that the operations of these mysterious factors in Alabama 1937–1938, as compared with 1938–1939, are largely among the gravis and gravis-like strains. Thus, in 1937–1938 9.7 per cent of the 93 Alabama cultures were gravis and gravis-like and 11 per cent of these were virulent. In

1938–1939, 38.4 per cent of the 104 Alabama cultures were gravis and gravis-like and 30 per cent of these were virulent (Table 3).

TABLE 3

Increase in Prevalence of Gravis Strains, Especially Virulent Gravis Strains, in Alabama

Survey	*Total Cultures*	*Per cent of Cultures Found to Be Gravis*	*Per cent of Gravis Cultures Virulent*
1937–1938	93	9.7	11.0
1938–1939	104	38.4	30.0

Coming, finally, to the fourth of the questions listed at the beginning of this paper a complete answer is not yet available. It is plain enough, as already shown, that considerable changes in type and virulence of organisms and their prevalence, as well as in morbidity and natural immunity rates, have occurred in two seasons and in different places; but whether these changes represent trends which will continue in the direction indicated and thus serve as useful guides in diphtheria control remains to be seen.

The explanation of the curious phenomena related to the natural history of diphtheria uncovered by this study is admittedly obscure. It would seem of the greatest interest to continue to follow these same lines of investigation as far as possible, perhaps extending the work to other parts of the country, ever bearing in mind the fact that the utility of information about natural phenomena is not always immediately apparent and depends in large degree upon the extent of our knowledge concerning it.

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Diphtheria Immunity and Carrier Surveys in New York State

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SCHICK test surveys and carrier surveys have been carried out in two New York State cities as a part of a study of diphtheria immunity and carrier prevalence in various places in the United States and Canada, sponsored by the diphtheria sub-committee of the Committee on the Evaluation of Administrative Practices of the American Public Health Association. The procedure followed in these surveys and the method of study are the same as those carried out in the other study areas, which have previously been described in detail.

The cities selected in New York State for this study were Kingston and Ossining. Kingston is a city of approximately 30,000 population, located on the Hudson River midway between Albany and New York City. It was selected for this study for several reasons: first, because a small but carefully conducted Schick test survey had been carried out by the late Dr. F. W. Laidlaw in 1922, immediately preceding the first use of toxin-antitoxin in that city; second, because unusually complete and accurate morbidity and immunization records were available; and third, because the history of diphtheria in Kingston during the past 15 years has been in general similar to the history of this disease in many cities of similar size in the state. Unfortunately, no accurate records of earlier carrier surveys are available for comparison.

Ossining is a village of approximately 15,000 population, located in Westchester County on the lower Hudson River, and because of its proximity to New York City a part of its population is made up of commuters. It was included in this study because in general the history of diphtheria in the village had been similar to that in Kingston and the rest of the state, with the exception that a distinct increase in diphtheria morbidity occurred in 1938 immediately preceding the survey.

Table 1 shows diphtheria morbidity in Kingston and Ossining from 1908 through 1938. Diphtheria was highly prevalent in Kingston and Ossining during the period 1908 to 1920, as it was throughout the state. Beginning soon after 1920, there was a marked decrease in the incidence of the disease in both Kingston and Ossining, which was roughly parallel to the decrease in the state as a whole. No cases occurred in Kingston for the 4 year period 1933 to 1936. One case occurred in 1937 and 1 in 1938. No cases occurred in Ossining from 1930 through 1935. One case occurred in 1936, none in 1937, and 6 cases occurred just preceding the survey.

As previously stated, a Schick test survey was carried out in the public and parochial schools of Kingston in 1922. Table 2 shows the results of this survey which preceded the first artificial immunization in that area but which was carried out at a time when clinical

TABLE 1

Diphtheria Morbidity Rates per 100,000 Population in Kingston, N. Y., and Ossining, N. Y., 1908–1938

Year	Diphtheria Morbidity Rate per 100,000 Population		Year	Diphtheria Morbidity Rate per 100,000 Population	
	Kingston	Ossining		Kingston	Ossining
1908	393.6	239.9	1925	81.9	26.4
1909	224.8	491.2	1926	14.2	...
1910	169.7	276.0	1927	17.8	8.1
1911	42.3	353.8	1928	21.4	31.9
1912	130.3	90.0	1929	21.4	15.3
1913	99.3	69.2	1930	3.6	30.1
1914	57.1	107.6	1931	7.1	7.4
1915	68.3	232.7	1932	7.1	22.0
1916	143.8	206.6	1933	...	....
1917	67.9	99.8	1934	...	....
1918	184.4	131.7	1935	...	....
1919	480.3	1069.7	1936	...	7.1
1920	126.8	622.1	1937	3.5	....
1921	166.2	454.6	1938	3.5	41.5
1922	153.6	153.4			
1923	50.7	102.4			
1924	82.6	18.1			

diphtheria was and had been highly prevalent. It may be noted that of 501 children who were Schick tested, 166, or 33 per cent, were Schick-negative, representing the result of natural processes of immunization. It is of interest to note that 36 per cent of the group 0–4 years of age were Schick-negative.

A Schick test survey was carried out in Kingston in March and April of 1938, in which 2,600 children were tested. It was possible to confirm history of previous immunization with unusual certainty as complete records from the earliest immunization in the city health department were available and the records of immunizations performed by practising physicians were unusually complete and accurate. Six hundred and seven children gave no history of immunization, nor was there any record of immunization of these children in the Department of Health nor from records obtained from practising physicians. While the percentage of the total number giving no history of immunization found to be Schick-negative is approximately the same as that found in 1922, it is of interest to note that natural Schick-negatives in the group of children under 10 years of age in 1938 is low as compared to findings in 1922.

A diphtheria carrier survey was carried out in Kingston beginning on January 25, and completed on March 11, 1938. This survey was carried out in the public and parochial schools; the same proportion of children was cultured in each school as the population of that school formed of the total school population of the city. An effort was also made to distribute in so far as possible the children cultured throughout the various age groups in each

TABLE 2

Kingston Schick Test Survey, 1922

Age Group	Number Tested	Number Negative	Per cent Negative
0– 4 years	60	22	36.7
5– 9 "	254	78	30.8
10–14 "	165	56	33.9
15 years and over	22	10	45.4
Total	501	166	33.1

TABLE 3

Schick Test Study in Kingston, N. Y., March and April, 1938
Schick Test Reactions by History of Previous Diphtheria Immunization for Certain Age Groups

Age at Time of Schick Test	History of Previous Immunization			No History of Immunization			Total		
		Negative			Negative			Negative	
	Number Tested	Number	Per cent	Number Tested	Number	Per cent	Number Tested	Number	Per cent
0– 4	17	12	70.6	15	0	0.0	32	12	37.5
5– 9	591	463	78.3	198	35	17.7	789	498	63.1
10–14	823	709	86.1	266	118	44.4	1,089	827	75.9
15 & over	552	478	86.6	109	58	53.2	661	536	81.1
Unknown	15	11	73.3	19	7	36.8	34	18	52.9
Total	1,998	1,673	83.7	607	218	35.9	2,605	1,891	72.6

school. Table 4 shows the results of the diphtheria carrier survey in Kingston in January, 1938, according to sex and age. Fifteen cultures obtained in this survey contained organisms morphologically and culturally characteristic of *Corynebacterium diphtheriae*. Only one of these strains was found to be virulent.

A second carrier survey was carried out in Kingston in the same schools during November and the first week of December, 1938. No attempt was made to culture the same individuals who were cultured in the first survey, but it was found that approximately 35 per cent of those cultured in the second survey had been cultured in the first. Table 5 shows the results of this survey. It may be noted that of the 1,742 individuals cultured, 26 were carriers of organisms morphologically and culturally characteristic of *Corynebacterium diphtheriae*, but that none of these were found to be virulent.

The same Schick testing and culturing procedures were followed in the City of Ossining. Table 6 shows the results of a Schick test survey carried out in September and November, 1938. An unusually high proportion of children had received immunizing treatment, and of the 884 tested, only 78 gave no history of previous immunization. Of the total tested who had had previous immunizing treatment, 72 per cent were found to be Schick-negative as compared with 83 per cent found Schick-negative following immunizing treat-

TABLE 4

Diphtheria Carrier Study in Kingston, N. Y., January 25–March 11, 1938
Cultures Taken According to Sex and Certain Age Groups

Age Group	Number Cultured			Number with Positive Cultures						Per cent Positive Cultures					
				Male		Female		Total		Male		Female		Total	
	Male	Female	Total	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.
5– 9	309	333	642	2	0	1	0	3	0	0.6	..	0.3	....	0.5	....
10–14	410	364	774	8	0	4	1	12	1	2.0	..	1.1	0.27	1.6	0.13
15 & over	42	21	63	0	0	0	0	0	0	...	..	...	....	...	....
Not stated	1	1	2	0	0	0	0	0	0	...	..	...	....	...	....
Total	762	719	1,481	10	0	5	1	15	1	1.3	..	0.7	0.14	1.0	0.07

Only one strain proved virulent when tested on guinea pigs; that from a female aged 10 years.

TABLE 5

Diphtheria Carrier Study in Kingston, N. Y., October 25–December 6, 1938
Cultures Taken According to Sex and Certain Age Groups

Age Group	Number Cultured			Number with Positive Cultures						Per cent Positive Cultures					
				Male		Female		Total		Male		Female		Total	
	Male	Female	Total	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.
5– 9	512	459	971	4	0	4	0	8	0	0.8	..	0.9	....	0.8	....
10–14	413	313	726	7	0	11	0	18	0	1.7	..	3.5	....	2.5	....
15 & over	28	17	45	0	0	0	0	0	0	...	..	...	....	...	....
Total	953	789	1,742	11	0	15	0	26	0	1.2	..	1.9	....	1.5	....

TABLE 6

Schick Test Study in Ossining, N. Y., September–November, 1938
Schick Test Reactions by History of Previous Diphtheria Immunization for Certain Age Groups

Age at Time of Schick Test	History of Previous Immunization			No History of Previous Immunization			Total		
		Negative			Negative			Negative	
	Number Tested	Number	Per cent	Number Tested	Number	Per cent	Number Tested	Number	Per cent
0– 4	11	3	27	0	..	..	11	3	27
5– 9	538	362	67	53	17	32	591	379	64
10–14	330	268	81	25	21	84	355	289	81
15 & over	5	5	100	0	..	..	5	5	100
Total	884	638	72	78	38	49	962	676	70

TABLE 7

Diphtheria Carrier Study in Ossining, N. Y., January–February, 1939
Cultures Taken According to Sex and Certain Age Groups

Age Group	Number Cultured			Number with Positive Cultures						Per cent Positive Cultures					
				Male		Female		Total		Male		Female		Total	
	Male	Female	Total	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.	Morph. Pos.	Vir.
5– 9	293	250	543	2	2	1	0	3	2	0.7	0.68	0.4	....	0.6	0.37
10–14	268	265	533	1	..	5	1	6	1	0.4	....	1.9	0.38	1.1	0.19
15 & over	3	3	6	0	0	0	0	0	0	...	....	...	....	...	....
Total	564	518	1,082	3	2	6	1	9	3	0.5	0.35	1.2	0.19	0.8	0.28

TABLE 8

Diphtheria Carrier Surveys

Place	Number of Persons Examined	C. diphtheriae Isolated		Toxigenic C. diphtheriae Isolated	
		Number	Per cent	Number	Per cent
Kingston, Jan.–May, 1938	1,481	15	1.0	1	0.07
Kingston, Nov.–Dec., 1938	1,742	26	1.5	0	....
Total Kingston, 1938	3,223	41	1.3	1	0.03
Ossining, Jan.–Feb., 1939	1,082	9	0.8	3	0.28

TABLE 9

Rapidity of Natural Immunization as Shown by Schick Test Survey of Children Giving No History of Artificial Immunization, Kingston, N. Y.—1922 and 1938

	1922 Survey			1938 Survey		
		Negative			Negative	
Age Group	Number Tested	Number	Per cent	Number Tested	Number	Per cent
0– 4 years	60	22	36.7	15	0	0
5– 9 "	254	78	30.7	198	35	17.7
10–14 "	165	56	33.9	266	118	44.4
15 years and over	22	10	45.5	109	58	53.2
Total	501	166	33.1	588	211	35.9

ment in the City of Kingston. Forty-nine per cent of the 78 individuals giving no history of previous immunization were found to be naturally Schick-negative.

A carrier survey was carried out in Ossining in January and February, 1939, and of 1,082 individuals cultured, 9 were found to be carriers of micro-organisms morphologically and culturally characteristic of *Corynebacterium diphtheriae*. Three of these cultures were found to be virulent.

Summarizing the results of the carrier surveys in these two areas, as shown in Table 8, the percentage of persons cultured in the first Kingston study found to be carriers of morphologically positive *Corynebacterium diphtheriae* does not differ markedly from that found in the second Kingston survey, nor from the findings in Ossining. However, the proportion of virulent organisms isolated in Ossining is significantly higher than in either of the Kingston surveys.

The effect of the present low prevalence of carriers of virulent *Corynebacterium diphtheriae* upon natural immunization apparently is reflected in the rapidity of natural immunization, as shown in the Schick test surveys in Kingston in 1922 and in 1938. Table 9 shows natural immunization as measured by the Schick test at the end of the two surveys according to age groups. It may be noted that in the age group 0–4 years, 36 per cent were Schick-negative as a result of natural processes of immunization in 1922. The group tested in this age group in 1938 was too small to be of significance. However, in the age group 5–9 years, 17.7 per cent were found to be Schick-negative. Moreover, a tabulation by individual years of age within this age group shows that less than 5 per cent of those 6 years of age were Schick-negative in the group tested in 1938. If it may be assumed that this is a measure of cumulative natural immunization, a comparison may be made of the results of natural immunization for the two periods.

In the 1922 survey, it was shown that approximately 35 per cent of the population under 5 years of age were rendered Schick-negative by natural processes, whereas as nearly as can be determined from the 1938 survey, the cumulative effect of natural immunizing processes resulted in immunization of not more than 5 per cent. The total " immunes " in a given population is a summation of immune individuals resulting from natural and artificial processes and, based on the evidence of diminishing natural immunization in Kingston, the ultimate effect of the artificial immunization of any given proportion of the population would have differed considerably in the two periods

TABLE 10

Estimates of Natural and Artificial Immunization Against Diphtheria, 1922 and 1938, Based on Evidence of Natural Immunization as Shown by Schick Test Surveys in Kingston, N. Y.

Per cent Population Given Immunizing Treatment	1922				1938			
	Natural Immunes	Artificial Immunes	Total Immunes	Per cent of Population Immune	Natural Immunes	Artificial Immunes	Total Immunes	Per cent of Population Immune
30	350	166	516	51.6	50	256	306	30.6
35	350	193	543	54.3	50	299	349	34.9
40	350	221	571	57.1	50	342	392	39.2
45	350	249	599	59.9	50	385	435	43.5
50	...	...	...	....	50	428	478	47.8
55	...	...	...	....	50	470	520	52.0

under consideration. This effect might very possibly materially influence the administration of the control program. That is, artificial immunization of a given proportion of individuals in which there was considerable natural immunity would have quite a different ultimate result from the immunization of the same proportion of a group having no naturally acquired immunity.

Table 10 shows an estimate of natural and artificial immunization against diphtheria in 1922 and 1938, based on the evidence of natural immunization as shown by the Schick test survey in Kingston, N. Y. These estimates are based on the assumption that 85 per cent of children given immunizing treatment in 1922 were rendered immune with the immunizing agent in general use at that time, and that 90 per cent of the children given immunizing treatment with immunizing agents in use in 1938 were rendered immune. This assumption is in keeping with reported results of the use of the different agents.

It may be observed that, according to this estimation, if 30 per cent of the population under 5 years of age were given immunizing treatments in 1922, the summation of artificial and natural immunity would result in the immunity of approximately 52 per cent of that population, whereas at the rate of natural immunization in 1938 if 30 per cent of the group were given immunizing treatment, the summation of natural and artificial immunization would result in immunity of approximtaely 31 per cent of the population. It may also be observed that, based on these estimates, in 1938 the artificial immunization of 55 per cent of this age group would be required in order to accomplish the ultimate immunization of the same proportion of the population that was immunized by the treatment of 30 per cent of the population in 1932.

SUMMARY

Carrier surveys in two New York State cities have shown that the prevalence of carriers of virulent *Corynebacterium diphtheriae* is extremely low. Schick test surveys have shown that a high proportion of school children are immune, but that in the cities surveyed this is largely the result of artificial immunization. There is at least suggestive evidence that natural immunization is decreasing, if it can be assumed that the Schick test results in individuals giving no history of artificial immunization in 1922 and 1938 is a measure of the rapidity of natural immunization. It is suggested that the low prevalence of virulent diphtheria bacilli has resulted in decreased natural stimulation to immunity.

NOTE: The author is indebted to Dr. Edward S. Godfrey, Jr., for advice and suggestions in carrying out the study and in the interpretation of the results, and to Morton Robins for assistance in tabulation of the data.

Diphtheria Immunization with Fluid Toxoid and Alum Precipitated Toxoid*

Progress Report

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THESE studies were planned to investigate the height and duration of the antitoxic immunity following immunization with fluid and alum precipitated diphtheria toxoid. For methods and details of the study, the reader is referred to the previous communication.[1] In this progress note only the most important results of the study will be brought up to date. A complete report will be made at a future date.

Since the last report, 723 children have been added, bringing the total number of children under observation to 2,523. A condensed summary of the age distribution of these children is shown in Table 1.

TABLE 1

Age Distribution of Children in the Study

Age	*Number*	*Per cent*
8 months–5 years	479	18.9
6 years–10 years	1,665	66.0
11 years–17 years	379	15.0

The diphtheria carrier survey has been extended for the 4th consecutive year; and the children under observation continued to live in an environment with low incidence of carriers of virulent diphtheria organisms. In this connection it might be of interest to report the following record of diphtheria incidence:

1936	4 cases
1937	3 cases
1938	None
1939 up to Oct. 15, 1939	None

Actually, of over 3,992 cultures taken in 1939, only one, or 0.03 per cent, contained virulent *Corynebacterium diphtheriae*. Since 1936, 12,667 children have been cultured and a total of 25,210 cultures taken. The total number of children with positive KL cultures was 95, or 0.75 per cent. The results of the carrier survey are summarized in Table 2.

A summary of the antitoxin response to the different immunizing procedures is given in Table 3. Complete and significant figures are available for 4 months and 12 months after injection for each of the 4 procedures under study. Some results are available for 24 months and 36 months after injection, and these data are included for completeness.

It can be seen from Table 3 that the relative positions of the four groups when placed in an ascending scale of

* These studies are being carried out under a grant from the American Public Health Association and the U. S. Public Health Service, in coöperation with the Saginaw County Health Department and the Michigan State Department of Health.

† With the technical assistance of Anita Leavitt, Ann Sonderman, and Louise Hagaman.

TABLE 2

Results of Carrier Survey

Time	Number of Children Cultured *	Number of Children with Positive KL Culture		Number of Children with Pathogenic KL Culture		Number of Children with Non-pathogenic KL Culture		Number of Children with Positive KL Culture (No virulence test made)	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Length of Study 1936–1939	12,667	95	0.75	34	0.27	47	0.37	14	0.11

* A total of 25,210 cultures have been taken and examined, or approximately two per child.

TABLE 3

Comparison of Antitoxin Response to Different Immunizing Procedures in Children Having Less Than 0.001 Unit of Antitoxin per cc. of Serum at the Time of the First Injection

Procedure	Interval Between First Injection and Antitoxin Titration											
	4 Months			12 Months			24 Months			36 Months		
	No. of Cases	% .001 or More	% .01 or More	No. of Cases	% .001 or More	% .01 or More	No. of Cases	% .001 or More	% .01 or More	No. of Cases	% .001 or More	% .01 or More
2 injections fluid toxoid 3 wk. interval	240	65.5	32.5	183	57.9	27.9	114	50.8	24.6	...	....	....
1 injection alum precipitated toxoid	413	92.0	58.1	379	88.1	49.0	361	79.8	36.6	120	70.0	23.3
3 injections fluid toxoid 3 wk. interval	393	96.2	71.2	203	94.2	64.5	51	92.2	68.6	...	....	....
2 injections alum precipitated toxoid 2 wk. interval	332	100.0	96.0	203	100.0	92.7	...	....	....	...	....	....

antitoxin response has so far not changed with time. It seems definite from the results in Table 3 that the use of 2 injections of fluid toxoid with a 3 week interval is definitely inferior to the other procedures tried as a means of stimulating antitoxin response in children. If the group of all children having 0.01 unit or more of antitoxin per cc. of serum is taken as the level of comparison, it can be seen that even after 12 months 1 injection of alum precipitated toxoid has stimulated more children (49.0 per cent) to this high level than 2 injections of fluid toxoid did at the peak titration 4 months after injection (32.5 per cent). The level of 0.01 unit of antitoxin per cc. of serum is considered by many to insure a Schick-negative reaction in the individual.

It would seem that the health officer would be justified in choosing one of the other three methods of immunization (3 injections of fluid, 1 injection of alum precipitated, or 2 injections of alum precipitated toxoid) in preference to 2 injections of fluid toxoid given with a 3 week interval.

REFERENCE

1. Volk, Vladimir K., and Bunney, William Edward. *A.J.P.H.*, 29, 3:197 (Mar.), 1939.

Diphtheria Studies, Toronto

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Diphtheria Carrier Surveys, Toronto

The results of diphtheria carrier surveys in Toronto are shown in Table 1. These surveys were carried out with the coöperation of Dr. Gordon Jackson, Medical Officer of Health, Dr. A. B. Moffat, Bacteriologist of the Department of Public Health, City of Toronto, and the School of Hygiene.

TABLE 1

Diphtheria Carrier Surveys in School Children
Toronto, 1934–1939

	Number Cultures Examined	*Number Positive*	
		Morphology	*Virulence*
1934—			
May–June	1,453	16	0
Nov.–Dec.	1,335		
1935—			
Jan.–June	1,821	12	0
1935–36—			
Nov.–April	1,862	6	1
*1936—			
Oct.–Dec.	1,145	24	2
*1937—			
Jan.–May	1,327	19	2
1938—			
Jan.–June	1,800	5	0
Oct.–Dec.	848	5	0
1939—			
May–June	969	1	0
Total	12,560	88 (0.7%)	5 (0.04%)

* All cultures plated on tellurite blood agar

In general, children presenting themselves for physical examination in the public schools had nose and throat swabs taken by the physician. Approximately 200 such cultures were obtained each week from children of schools scattered throughout the city. In this way the survey represents a cross-section of the school population during the time of the survey which was in this sense continuous. These swabs were rubbed upon one slope of Loeffler's medium, examined by a bacteriologist, and "positive" or "suspicious" cultures sent to the School of Hygiene where the cultures were plated upon tellurite blood agar for identification. The utilization of dextrose, saccharose, and starch was determined, and intradermal virulence tests on rabbits were carried out upon colony cultures when indicated on the basis of these tests—i.e., utilization of dextrose, non-utilization of saccharose. From October, 1936, to May, 1937, 2,472 cultures were plated on tellurite blood agar without an initial microscopic examination for the morphological appearance of the culture.

During the period of these carrier surveys the diphtheria case rate was low in Toronto. The following are the case rates per 100,000 population in the respective years 1934 to 1939: 3.5, 7.2, 7.0, 6.0, 4.0, 1.1 (Jan.–Sept.). There were no deaths in 1934 and in 1937. The population of Toronto is 648,300 (1937).

TABLE 2

Diphtheria Antitoxin in Sera of Children, by Age Groups and Locality

	Amos, Que.				*Toronto, Ont.*				*Winnipeg, Man.*			
	<1/500 Unit		*>1/500 Unit*		*<1/500 Unit*		*>1/500 Unit*		*<1/500 Unit*		*>1/500 Unit*	
Age Group	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
0– 4 years	76	95	4	5	13	87	2	13	..	..	..	..
5– 9 years	228	82	51	18	118	84	23	16	91	94	6	6
10–14 years	93	67	45	33	15	68	7	32	47	75	16	25

Diphtheria Antitoxin in the Sera of Uninoculated Children in Certain Localities in Canada

In Table 2 are shown the results of antitoxin titration of the sera of uninoculated children geographically widely separated in Canada. The sera from Quebec were collected in 1936 and in 1938 by Dr. Poliquin. The remaining sera were obtained in 1937, 1938, and 1939. Table 2 shows the per cent of sera from children of specified age groups falling into the two categories, those with more than 1/500 unit per cc. and those with less than 1/500 unit. If the Schick level is accepted as at or near 1/250 unit of antitoxin per cc. of serum, it is safe to assume that those children whose sera show less than 1/500 unit would be Schick positive and non-immune to diphtheria as judged by the generally accepted standards. One-third of the sera falling in the group of more than 1/500 unit were tested for 1/250 unit and all were found to contain more than 1/250 unit. Hence it is reasonable to infer that the vast majority of the children in the group of more than 1/500 unit would be Schick-negative. The localities are geographically widely separated. Amos is a newly settled mining center. The inhabitants have emigrated from many parts of the Province of Quebec. Winnipeg has a population of 223,103; Toronto, 648,300.

Table 3 is a recapitulation of Table 2, showing in summary the age groups from the three localities.

Table 4 shows the results reported by Dr. G. M. Little for children in the Red Deer Health District, Alberta. It is evident that a very high percentage of children, namely 96 per cent of the uninoculated control group, are Schick-positive. It is suggested that the problem of immunizing and keeping immune such a group living in a non-diphtheria environment is more acute than would be the case were they living in an environment where diphtheria is prevalent.

TABLE 3

Summary

Diphtheria Antitoxin in Sera of 835 Children—Amos, Toronto, Winnipeg

	<1/500 Unit		*>1/500 Unit*	
Age Group	*No.*	*%*	*No.*	*%*
0– 4 years	89	94	6	6
5– 9 years	437	85	80	15
10–14 years	155	70	68	30
Total	681	82	154	18

TABLE 4

Report of Schick Tests

Red Deer Full-time Health District

G. M. Little, M.D., D.P.H.

Toxoid Given	*No. Schick-Positive*		*No. Schick-Negative*		*Total*
1933	*1935*	*%*	*1935*	*%*	*Children*
1 dose	21	85	4	15	25
2 doses	24	25	71	75	95
3 doses	17	1.5	1,114	98.5	1,131
			Control Group		
0 doses	902	96	38	4	940

Per cent Distribution of Diphtheria Antitoxin 5 Years after 3 Doses of Toxoid and Diphtheria Antitoxin Response to a Secondary Stimulus

In Table 5 is shown the per cent distribution of antitoxin in the children 5 years after 3 doses (0.5, 0.5, 1.0 cc.) of fluid toxoid, as compared with the

TABLE 5

Diphtheria Antitoxin in Children
3 Months and 5 Years after 3 Doses of Toxoid

Locality	*Interval after Toxoid (0.5, 0.5, 1 cc.)*	*Number Tested*	*Per cent Distribution by Antitoxin Levels*		
			1/500 and>	*1/250 and>*	*1/50 and>*
Toronto	3 Months	108	99	99	94
Whitby	3 Months	134	97	93	82
Toronto	5 Years	209	96	90	66
Hamilton	5 Years	187	98	93	78
St. Catharines	5 Years	156	97	94	70
Total	5 Years	552	97	92	71

distribution 3 months after 3 doses. The 108 children of the Toronto group were selected on the basis of Schick test only. It was unfortunately not possible to obtain blood samples in this group initially. The Whitby group was selected on the basis of serum titration. Only those showing <1/1,000 unit were given 3 doses of fluid toxoid. The remainder of the children shown in the table were unselected. That is to say, their immunity status was not initially assessed in any way. One may be tempted to assume, judging by the comparison with other data presented for groups in Canada, that not more than 15 per cent might have been Schick-negative initially. Indeed, because of the ages of the groups the percentage of non-immunes may be assumed to be much less.

In Toronto all children were 2 years of age or under when given toxoid. In St. Catharines and Hamilton 66 per cent were 6 years old or under. It is evident from these and other data that antitoxic immunity diminishes over a period of time. Reinforcement of antitoxic immunity is desirable in children given toxoid during preschool life by a secondary stimulus ("dose de rappel" of Ramon) given a year or two after the basic immunizing doses, or at least on entering school. It is, of course, well known that the antitoxin response to a secondary stimulus is rapid and attains a relatively high level. This is well illustrated in Table 6 which shows the antitoxin response to 0.1 cc. of fluid toxoid given subcutaneously in a group of children who had 3 doses of fluid toxoid 5 years previously. In every instance the level of antitoxin rose to more than 1/20 unit. Of the 50 children, 20 might be considered as representing a Schick-positive group, 8 of whom had no detectable (<1/1,000 unit) antitoxin.

TABLE 6

Response to 0.1 cc. Toxoid in Persons Given 3 Doses of Toxoid 5 Years Previously

Number Tested	*Titer before 0.1 cc. Toxoid*	*Response in 5 Weeks*	
		>1/20 to ½ Unit	*>½ Unit*
8	<1/1,000	3	5
12	>1/1,000 to <1/250	2	10
30	>1/250 to <1/50	4	26

Recommended Diphtheria Immunization Procedures

RECOMMENDED procedures for obtaining community protection against diphtheria by artificial active immunization have been prepared by the Sub-Committee on Evaluation of Administrative Practices in response to a request of the Committee on Administrative Practice at its meeting on December 4, 1939.

The Sub-Committee on Diphtheria, which has undertaken comprehensive studies to determine the relative safety and value of various procedures and products employed in artificial active immunization, has preferred not to formulate recommendations until their studies have been completed.

There remain many controversial points and diversities of opinion with regard to recommendations for routine adoption by administrative officers of health.

The Sub-Committee on Diphtheria is not charged with making recommendations, but with scientific study of the facts upon which administrative practices may properly be based. The Evaluation Committee accepts responsibility for the following recommendations which they believe express the practices which, in the present state of our information and experience, should be followed by local and state health departments.

The Committee on Administrative Practice, on the recommendation of its Sub-Committee on Evaluation of Administrative Health Practices, offers the following advice to health officers on methods of artificial active immunization against diphtheria. It should be kept in mind, however, that while some of these recommendations are made on the basis of controlled observations and experiments, others are based upon results of uncontrolled and unverified experiences. These latter appear to be practicable but are undergoing further study at the present time.

It is recommended that:

1. The preferred practice should be for children under school age,[1] and preferably for those at the 9th month of life, (a) two doses of diphtheria toxoid, alum precipitated, with a 4 week or 1 month interval between the doses, or (b) three doses of diphtheria toxoid at 4 week or 1 month intervals.[2]

2. In communities where it is impracticable to give two doses of diphtheria toxoid, alum precipitated, or three doses of diphtheria toxoid, (1a or b), to all the children between 9 months and 10 years of age, it will probably be found that the giving of one dose of diphtheria toxoid, alum precipitated, to a large number of children of this age group is more effective in preventing diphtheria in the community than the use of the two or three doses (1a or b) for half as many children.

3. To those children receiving one injection of diphtheria toxoid, alum precipitated, a single reinforcing dose of not more than one-half the usual dose of an equivalent diphtheria toxoid, alum precipitated, preparation should be given to each child inoculated in infancy, just prior to the child's entering school at 5 or 6 years of age, or 3 to 5 years after the initial inoculation if

this has been carried out at some time later than the first year of life.[3]

4. As a routine procedure the performance of the Schick test 3 to 6 months after completion of the inoculations in infancy is not considered to be essential, although it may be desirable in private practice and whenever the personnel and condition of access to patients at public clinics makes this additional contact practicable.

5. (a) Children of 10 years of age or over who are known to be susceptible as the result of the Schick test should receive three doses of diphtheria toxoid at 4 week or 1 month intervals, or equivalent doses of toxin-antitoxin similarly spaced. (b) For susceptible adults who may be exposed by occupation to contact with the clinical or carrier stage of diphtheria, the use of diphtheria toxoid, alum precipitated, is not recommended. In the case of adults with occupational hazards (e.g., physicians, nurses, attendants in hospitals for communicable diseases) those reacting to a sensitivity test should not be inoculated[4]; others should receive three doses of diphtheria toxoid or toxin-antitoxin as advised for children over 10 years of age (5a). The routine period of Schick test should be 12 months after completion of inoculation, unless there is a special reason for giving the Schick test earlier. The immunity produced is probably at its highest 3 or 4 months after the completion of the inoculations.

6. The practice of administering diphtheria toxoid in two doses at 3 week intervals should be discontinued.

FOOTNOTES

1. If there has been failure to undertake active immunization of a child prior to school age, either of the initial immunizing procedures advised here for younger children can safely be employed for children up to the end of the 9th year of life.

2. The comparison of the response induced by two doses of diphtheria toxoid, alum precipitated, and three doses of diphtheria toxoid indicate a somewhat higher response produced by the use of the former, although the results in both have been extremely satisfactory. Only preparations of antigenic potency officially acceptable should be used.

3. Whatever the method of initial artificial active immunization used in infancy or early childhood, one reinforcing dose of half the size used in the initial dose, or series of doses, of an acceptable antigenic agent, whether diphtheria toxoid, or diphtheria toxoid, alum precipitated, should be given to the child at school age (5th to 6th year) or 3 to 5 years after the initial dose, if this was given later than the first year of life.

4. Some members of the Sub-Committee on Diphtheria have successfully protected adults reacting to the sensitivity test by using doses of toxoid or of toxin-antitoxin smaller than those used for non-reactors.

Committee on Evaluation of Administrative Practices

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Comparative Study of the Bacterial Flora of Grade A and Grade B Milk in New York City

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Comparative Study of the Bacterial Flora of Grade A and Grade B Milk in New York City

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THE proposal to abolish the grading of milk in New York City has raised the fundamental question, namely, "Is the continuance of the Grade A specifications with their accompanying extra precautions in sanitation and handling justified on public health or other considerations in view of their necessarily higher cost?" Any attempt to answer this question requires that a comparison be made of Grade A and Grade B milks, particularly from the point of view of their content of bacteria both in number and kinds. To supply the data needed for such a comparison, a study was undertaken by the DeLamar Institute of Public Health at the invitation of the Grade A Milk Association with funds provided by that organization. The work was begun in April, 1939, and was continued until the middle of March, 1940.

A study of somewhat similar nature was made for the Grade A Committee of Metropolitan New York by Dr. Walter L. Carr with the coöperation of a number of authorities on milk control.[1] In addition, to inspections of farms and receiving stations, tests were made on samples of milk for (1) Standard Methods counts (agar and Breed method), (2) coliform organisms in pasteurized milk, (3) streptococci in raw milk, (4) sediment test, and (5) Babcock test for fat. Farm inspections were made for the study by the late Dr. William H. Park who reported that "there is a very great difference in the average between conditions on the Grade A and Grade B farms. The Grade A farms rate much higher in cleanliness and in the handling of cows and milk." The Standard Methods counts showed that just before pasteurization Grade B raw milk contains on the average 6 times as many organisms per cc. as the Grade A milk, and after pasteurization 9 times as many as Grade A pasteurized. Hemolytic streptococci were commonly isolated, but human strains were not found in either milk. Coliform-positive samples were found twice as frequently among the Grade B pasteurized samples as among the Grade A pasteurized samples.

Our own study, reported below, was concerned solely with the bacterial flora of the two milks. After the publication of the Carr report a new medium for the Standard Methods count was adopted by the American Public Health Association. This made it desirable to restudy the comparative Standard Methods counts of the two milks. Streptococci were determined in both pasteurized and raw milks. For our coliform studies, which were made on both raw and pasteurized samples,

a quantitative plate method was substituted for the usual lactose broth technic. The present study also included identification of organisms growing on agar plates, quantitative counts on yeasts and molds, and counts of spores of clostridia. The effect of allowing milk to stand at room temperature, and its subsequent action on guinea pigs was also studied.

The Sanitary Code of the City of New York in effect during the period of this study gives in detail the conditions for the production and handling of Grade A and Grade B milks. In many respects, the regulations are alike for the two milks, the differences applying chiefly to the bacterial counts and temperatures at which the milk may be kept. Summarized, the differences are:

	Grade A Milk	*Grade B Milk*
Raw milk intended for country pasteurization, count not to exceed	100,000	300,000
Raw milk intended for city pasteurization, count not to exceed	200,000	750,000
Pasteurized milk, count not to exceed	30,000	50,000
Night's milk to be cooled to	50° F.	60° F.
Uncooled morning milk to be delivered to receiving stations before	8 A.M. summer 9 A.M. winter	9 A.M.
Age limit for pasteurized milk	36 hours	54 hours
Lip cover cap	required	not required

The requirements for pasteurization are identical.

In the case of Grade A milk the industry has added other requirements and regulatory procedures which serve practically to increase the difference between the two milks. The Grade A farmers have a more complete veterinary service than the Grade B farmers and have training and equipment to detect mastitis. An important additional control measure is the testing by plate counts of each Grade A source of milk 6 to 9 times a month. (The milk of each Grade B farm is tested once a month by microscopic test.) Grade A milk is sold to the consumer for an additional 1½ to 3 cents a quart. A farmer producing Grade A milk may

TABLE 1

Distribution of Samples

Part I—According to Place of Collection

Grade	*A Raw*	*B Raw*	*A Pasteurized*	*B Pasteurized*
Total number of samples	185	341	231	373
City pasteurizing plants	181	339	206	318
Country plants or receiving stations	4	2	16	4
Stores:				
Bottles	0	0	9	16
Paper containers	0	0	0	35
No. samples over 1 day old	0	0	19(9.8%)	11(3.6%)
Part II—According to Original Source				
No. of distributors represented	6	10	13	35
No. of city pasteurizing plants	9	16	14	41
No. of receiving stations	35	133	39	161
No. country pasteurizing plants	0	0	2	2

receive a share of this premium if he produces milk with a count of 25,000 or under, and an extra bonus if the milk has a count below 10,000.[1, 2]

LABORATORY STUDIES ON THE FLORA OF GRADE A AND GRADE B MILKS

The study of the comparative bacteriology of Grade A and Grade B milks was begun in April, 1939, and continued until the middle of March, 1940. In all, 1,130 samples were collected and studied, the total including 185 A raw, 231 A pasteurized, 341 B raw, and 373 B pasteurized milks. The distribution of the samples by place of collection and by the number of companies and pasteurizing plants may be found in Table 1.

Since the country pasteurized samples constitute such a small portion of the total, they have been incorporated with the city pasteurized milks in the tabulation of results.

Samples, on collection, were transported to the laboratory in ice when the weather required. In most instances the milk was ready for analysis within 2 or 3 hours after collection.

In the laboratory, tests were set up and inoculations made for:

1. Total count on Old Standard Methods Agar
2. Total count on New Standard Methods Agar
3. Count on blood agar
4. Microscopic count (Breed count)
5. Identification of genera and species of organisms found on plates.

TABLE 2

Standard Methods Counts

Month	*No. Samples*	*Counts*				*No. Samples Above Present Code Limits*
		Highest	*Lowest*	*Median*	*Geometric Mean*	
		Part I—Grade A Raw Milk on Old Agar				
Apr., 1939	..	....	....	....	....	..
May	..	....	....	....	....	..
June	20	360,000	17,000	23,000	42,000	1
July	12	320,000	2,500	29,000	28,000	1
Aug.	10	1,800,000	19,000	126,000	140,000	4
Sept.	8	180,000	5,200	28,000	27,000	0
Oct.	25	380,000	2,800	20,000	25,000	3
Nov.	19	450,000	14,000	25,000	35,000	1
Dec.	18	28,000	7,000	18,000	16,000	0
Jan., 1940	25	75,000	4,000	15,000	26,000	0
Feb.	22	90,000	8,000	29,000	26,000	0
Mar.	7	60,000	7,000	24,000	26,000	0
		Part II—Grade B Raw Milk on Old Agar				
Apr., 1939	..	....	....	....	....	..
May	..	....	....	....	....	..
June	29	1,500,000	60,000	170,000	210,000	2
July	29	3,900,000	65,000	230,000	310,000	5
Aug.	28	5,400,000	75,000	370,000	420,000	6
Sept.	23	2,000,000	42,000	430,000	400,000	5
Oct.	45	2,200,000	5,000	170,000	170,000	5
Nov.	36	1,000,000	5,000	98,000	110,000	1
Dec.	32	400,000	20,000	85,000	80,000	0
Jan., 1940	40	1,000,000	10,000	150,000	110,000	1
Feb.	31	1,200,000	15,000	200,000	150,000	2
Mar.	19	1,200,000	48,000	170,000	180,000	1

6. Quantitative count of coliform organisms.
7. Quantitative count of clostridia (*B. welchii*) spores
8. Quantitative count of yeasts and molds on Sabouraud's Agar
9. Toxicity test on guinea pigs (explained later)

The results of each of these tests are presented in the tables and text given below, together with a brief discussion of their possible significance.

BACTERIAL COUNTS OF GRADE A AND GRADE B MILKS

(Old and New Standard Methods Agar, Blood Agar)

The Standard Methods counts on the old agar and the new agar (adopted as the official medium of the American Public Health Association, July, 1939) are given in Tables 2 and 3.

In these tables, the median count may be considered as the most significant figure. Since it is the middle figure when the counts are arranged in numerical order, it puts no undue value on a few excessively high or very low counts which frequently occur in such a listing and which may considerably affect the arithmetic mean or average. The geometric mean (Charts I and II) has also been computed for each month because it is commonly used in reports of health departments. Its numerical value in most cases is very close to that of the median. The monthly median values for Grade A raw milk vary from 22,000 to 300,000. The value of 300,000 in August is out of all proportion to the rest of the figures, the next one in order of magnitude being 53,000. A

TABLE 2 (Cont.)

Standard Methods Counts

Month	*No. Samples*	*Counts*				*No. Samples Above Present Code Limits*
		Highest	*Lowest*	*Median*	*Geometric Mean*	
		Part III—Grade A Pasteurized Milk on Old Agar				
Apr., 1939	..	....	....	....	....	..
May	..	....	....	....	....	..
June	23	1,200	350	920	800	0
July	17	4,200	150	450	520	0
Aug.	10	28,000	80	1,600	1,400	0
Sept.	9	7,600	180	1,100	1,200	0
Oct.	21	3,800	130	960	820	0
Nov.	24	3,200	220	650	800	0
Dec.	25	1,200	40	500	390	0
Jan., 1940	35	6,400	100	360	350	0
Feb.	28	4,200	50	400	420	0
Mar.	9	900	50	100	250	0
		Part IV—Grade B Pasteurized Milk on Old Agar				
Apr., 1939	..	....	....	....	....	..
May	..	....	....	....	....	..
June	34	85,000	2,200	8,900	7,500	2
July	34	81,000	560	9,500	9,800	0
Aug.	28	22,000	1,200	5,800	5,100	0
Sept.	21	41,000	2,300	8,100	9,600	1
Oct.	50	2,500,000	1,300	9,300	8,200	2
Nov.	33	60,000	1,200	9,500	8,000	1
Dec.	32	90,000	450	11,000	9,600	1
Jan., 1940	45	200,000	380	6,800	6,200	2
Feb.	35	32,000	900	10,000	7,800	0
Mar.	20	85,000	1,500	5,500	6,700	2

TABLE 3

Standard Methods Counts

Part I—Grade A Raw Milk on New Agar

Month	No. Samples	Counts: Highest	Lowest	Median	Geometric Mean	No. Samples Above Present Code Limits
Apr., 1939	..	....	....	....	....	..
May	13	80,000	10,000	23,000	27,000	0
June	20	6,000,000	16,000	53,000	69,000	2
July	12	550,000	4,500	37,000	48,000	1
Aug.	10	3,500,000	31,000	300,000	270,000	6
Sept.	8	220,000	15,000	48,000	53,000	1
Oct	25	620,000	6,200	46,000	54,000	3
Nov.	19	750,000	20,000	45,000	57,000	1
Dec.	18	480,000	12,000	35,000	45,000	2
Jan., 1940	25	120,000	9,500	22,000	22,000	0
Feb.	22	220,000	16,000	45,000	41,000	2
Mar.	7	120,000	10,000	40,000	40,000	0

Part II—Grade B Raw Milk on New Agar

Apr., 1939	..	....	....	....	....	..
May	29	1,900,000	86,000	310,000	320,000	5
June	29	45,000,000	160,000	510,000	610,000	9
July	29	6,600,000	65,000	400,000	570,000	9
Aug.	28	12,000,000	180,000	890,000	960,000	16
Sept.	23	6,300,000	45,000	550,000	400,000	8
Oct.	45	4,300,000	35,000	440,000	440,000	16
Nov.	36	2,500,000	40,000	180,000	190,000	1
Dec.	32	750,000	25,000	160,000	140,000	0
Jan., 1940	40	830,000	17,000	190,000	170,000	1
Feb.	31	1,900,000	40,000	240,000	270,000	4
Mar.	19	1,700,000	75,000	270,000	300,000	3

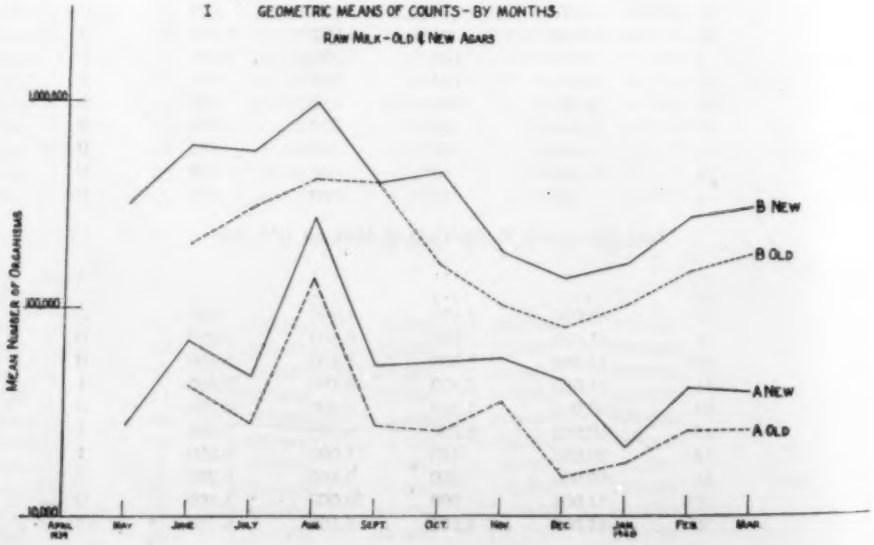
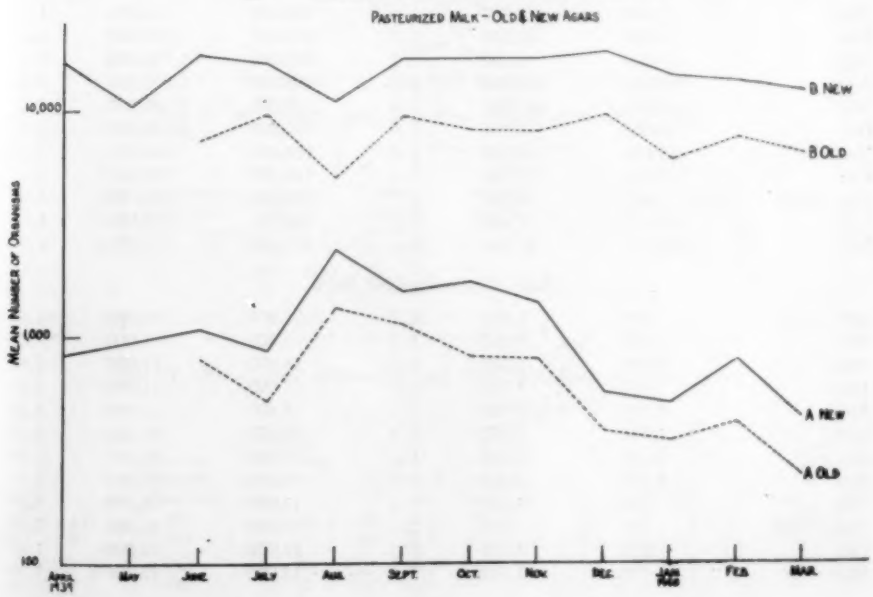


TABLE 3 (Cont.)

Standard Methods Counts

Month	*No. Samples*	*Counts*				*No. Samples Above Present Code Limits*
		Highest	*Lowest*	*Median*	*Geometric Mean*	
		Part III—Grade A Pasteurized Milk on New Agar				
Apr., 1939	6	1,500	350	700	830	0
May	20	210,000	180	1,000	960	1
June	23	2,600	460	1,100	1,100	0
July	17	4,600	100	820	870	0
Aug.	10	42,000	100	1,600	2,400	1
Sept.	9	15,000	430	1,500	1,600	0
Oct.	21	7,500	520	2,200	1,800	0
Nov.	24	3,900	250	1,300	1,400	0
Dec	25	1,800	180	720	580	0
Jan., 1940	35	2,500	120	450	520	0
Feb.	28	2,600	200	850	820	0
Mar.	9	1,800	120	500	450	0
		Part IV—Grade B Pasteurized Milk on New Agar				
Apr., 1939	7	77,000	5,300	17,000	17,000	1
May	33	620,000	1,200	9,500	11,000	3
June	34	130,000	3,400	13,000	18,000	7
July	34	110,000	1,800	13,000	17,000	4
Aug.	28	98,000	1,400	8,400	12,000	2
Sept.	21	65,000	3,600	12,000	17,000	1
Oct.	50	250,000	3,500	17,000	17,000	5
Nov.	33	92,000	4,500	15,000	17,000	2
Dec	32	200,000	2,300	12,000	18,000	6
Jan., 1940	45	290,000	560	13,000	15,000	5
Feb.	35	60,000	1,800	21,000	14,000	1
Mar.	20	90,000	1,200	12,000	13,000	4

II GEOMETRIC MEANS OF COUNTS - BY MONTHS



second figure of interest is the number of samples above the limits prescribed by the code. In the case of Grade A raw it was 18 out of 182 samples tested (new agar).

The grade B raw milks varied in median counts from 160,000 to a high of 890,000, the largest figure being that for August. The figures between these two values are fairly evenly spaced. Seventy-two samples were above the code limits out of a total of 337 milks tested.

Among the pasteurized milks, the median counts varied from 450 to 2,200 in the Grade A, the largest figure being that for October. Two samples out of 231 were above the prescribed limits of the code. Among the Grade B samples, the figures varied from 8,400 to 21,000, with 41 out of 370 exceeding the code limits (all new agar).

While the median counts may be taken as the best index of milk quality, the presence in any group of counts of unusually high numbers is worthy of attention. Thus, the median for two series of milk counts may be identical, but the figures above the median in one case may be very close to the median, while in the second case there may be a considerable spread between the median and the highest count. Obviously, quality as represented by the second series of counts is inferior to that of the first. As a means of measuring this spread above the median value, the *upper quartile* is found, which is simply the median of the upper half of the series of numbers. The ratio of the

TABLE 4

Median Counts (M), Upper Quartiles (Q), and Ratio (Q/M), by Months for Each Kind of Milk (Based on New Standard Methods Agar Counts)

Part I—Raw Milk

	Grade A			*Grade B*		
Months	*Median*	*Upper Quartile*	*Ratio*	*Median*	*Upper Quartile*	*Ratio*
Apr., 1939	....	....	...	....	....	...
May	23,000	37,000	1.6	310,000	410,000	1.3
June	53,000	89,000	1.7	510,000	890,000	1.7
July	37,000	45,000	1.2	400,000	1,700,000	4.2
Aug.	300,000	480,000	1.6	890,000	1,800,000	2.0
Sept.	48,000	140,000	2.9	550,000	1,100,000	2.0
Oct.	46,000	72,000	1.6	440,000	1,200,000	2.7
Nov.	45,000	90,000	2.0	180,000	400,000	2.2
Dec.	35,000	75,000	2.1	160,000	220,000	1.4
Jan., 1940	22,000	38,000	1.7	190,000	310,000	1.6
Feb.	45,000	55,000	1.2	240,000	450,000	1.9
Mar.	40,000	42,000	1.1	270,000	650,000	2.4
		Part II—Pasteurized Milk				
Apr., 1939	700	1,400	2.0	17,000	20,000	1.2
May	1,000	1,300	1.3	9,500	21,000	2.2
June	1,100	1,300	1.2	13,000	23,000	1.8
July	820	1,700	2.1	13,000	31,000	2.4
Aug.	1,600	3,100	1.9	8,400	24,000	2.9
Sept.	1,500	1,700	1.1	12,000	31,000	2.6
Oct.	2,200	3,600	1.6	17,000	49,000	2.9
Nov.	1,300	2,000	1.5	15,000	28,000	1.9
Dec.	720	1,100	1.5	12,000	58,000	4.8
Jan., 1940	450	950	2.1	13,000	42,000	3.2
Feb.	850	1,100	1.3	21,000	29,000	1.4
Mar.	500	1,600	3.2	12,000	22,000	1.8

upper quartile to the median then expresses the variability of the figures above the median; a ratio close to unity thus indicates that the figures above the median are not far from it numerically. These ratios are given in Table 4 for the Grades A and B milk counts on the new agar.

The distribution of the ratios is as follows:

Grade A milk 23 ratios 9 between 1.1 and 1.6
9 between 1.6 and 2.1
5 2.1 and above
highest ratio = 3.1
average = 1.7

Grade B milk 23 ratios 4 between 1.1 and 1.6
8 between 1.6 and 2.1
11 2.1 and above
Highest ratio = 4.8
average = 2.3

These results show that the variability of the Grade B milk is greater than that of Grade A or, to express the matter in another way, Grade A milk is a more uniform product, from the bacteriological standpoint, than is Grade B.

The distribution of all of the counts on old and new agar is given in Table 5.

These results show the comparative predominance of Grade A samples among the low counts and the relative shift in groupings which results from the use of the new agar.

A comparison of the geometric means of the raw milk with those of the pasteurized gives an overall measure of what may be termed the pasteurizability of each milk, or the efficiency of the pasteurization process. In Table 6 this relationship is expressed as the percentage of organisms surviving pasteurization.

It will be noted that in practically all cases, the percentage survival is smaller in the Grade A milks than in the Grade B, a fact which signifies that Grade A milk is more efficiently pasteurized or that there are present in Grade B milks organisms which are less susceptible to pasteurization than those which are found in Grade A milk. The differences between the old and new agars are not very great.

A comparison of the geometric means of Grade A milk and Grade B milk gives a relationship which sums up in a single figure, the comparative quality

TABLE 5

Distribution of Standard Methods Counts

Part I—Raw Milk—Old and New Standard Methods Agar

Grade	No. of Samples Examined	Grouping of Counts: 10,000 and Under		10,001–50,000		50,001–100,000		100,001–200,000		200,001–500,000		500,001–750,000		Over 750,000	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
A raw (new)	182	4	2.2	105	57.7	37	20.4	20	11.0	8	4.4	3	1.7	5	2.7
B raw (new)	341	0	0	15	4.4	39	11.4	63	18.5	114	33.5	37	10.8	73	21.4
A raw (old)	152	17	11.2	106	69.8	16	10.5	3	2.0	7	4.6	1	0.6	2	1.3
B raw (old)	286	3	1.0	47	16.4	42	14.7	70	24.5	82	28.7	14	4.9	28	9.8

Part II—Pasteurized Milk—Old and New Standard Methods Agar

Grade	No. of Samples Examined	Grouping of Counts: 1,000 and Under		1,001–5,000		5,001–10,000		10,001–30,000		30,001–50,000		Above 50,000	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
A past. (new)	227	110	48.5	108	47.6	5	2.2	2	0.8	1	0.4	1	0.4
B past. (new)	373	1	0.3	42	11.2	82	22.2	161	43.1	42	11.2	45	12.0
A past. (old)	182	143	78.6	35	19.2	3	1.7	1	0.6	0	0	0	0
B past. (old)	299	6	2.0	101	33.8	80	26.7	94	31.5	9	3.0	9	3.0

TABLE 6

Mean Percentage Survival of Organisms in Pasteurized Milk by Months *

Month	Grade A		Grade B	
	New Agar	Old Agar	New Agar	Old Agar
Apr., 1939	...	...	...	...
May	3.6	...	3.4	...
June	1.6	1.9	2.9	3.6
July	1.8	1.9	3.0	3.1
Aug.	0.89	1.0	1.2	1.2
Sept.	3.0	4.3	4.3	2.4
Oct.	3.3	3.3	3.9	4.8
Nov.	2.5	2.3	8.9	7.3
Dec.	1.3	2.4	12.9	12.0
Jan., 1940	2.4	2.2	8.8	5.6
Feb.	2.0	1.6	5.2	5.2
Mar.	1.1	0.96	4.4	3.7
Average	2.1		5.3	

* Values of $\left(\frac{\text{geometric mean of pasteurized milk} \times 100}{\text{geometric mean of raw milk}}\right)$

of the two milks for any given month or period. These comparisons are given in Table 7.

The figures vary (on the new agar) from 3.1 to 11.9 for the raw milks. For the period of the study the average was 7.1 (6.6 on the old agar), indicating a sevenfold difference in the raw milk counts of Grade A and Grade B milks. For the pasteurized milks, the difference is much greater, varying from 5 to 31 times, or an average of 17.4 times. This last figure, when compared to the 7.1 average above, gives another expression of the greater relative pasteurizability of Grade A milk.

It has generally been stated that the newly adopted agar medium has little effect on counts which are low on old agar, but that it may as much as double

TABLE 7

Comparison of Geometric Means of Grade A and Grade B Milks by Months

Part I—Raw Milk			*Part II—Pasteurized Milk*		
	Ratio B/A			Ratio B/A	
Month	Old Agar	New Agar	Month	Old Agar	New Agar
Apr., 1939	...	...	Apr., 1939	...	20.6
May	...	10.2	May	...	11.4
June	5.0	8.9	June	9.4	16.3
July	11.2	11.9	July	18.8	19.5
Aug.	3.0	3.6	Aug.	3.6	5.0
Sept.	14.8	7.5	Sept.	8.0	10.6
Oct.	6.8	8.2	Oct.	10.0	9.5
Nov.	3.2	3.3	Nov.	10.0	12.2
Dec.	5.0	3.1	Dec.	24.6	31.0
Jan., 1940	4.2	7.8	Jan., 1940	17.7	29.0
Feb.	5.8	6.6	Feb.	18.5	17.1
Mar.	6.9	7.4	Mar.	27.0	29.0
Average	6.6	7.1	Average	14.8	17.4

TABLE 8

Distribution of Counts on Blood Agar

	No. of Samples	10,000 and Under		10,001–50,000		50,001–100,000		100,001–200,000		200,001–500,000		500,001–750,000		Over 750,000	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
A raw	182	18	10	121	66.4	26	14.3	8	4.4	6	3.3	0	0	3	1.6
B raw	337	0	0	38	11.3	61	18.1	86	25.5	88	26.1	23	6.8	41	12.2
	No. of Samples Examined	1,000 and Under		1,001–5,000		5,001–10,000		10,001–30,000		30,001–50,000		Over 50,000	
		No.	%	No.	%	No.	%	No	%	No.	%	No.	%
A past.	231	180	78.0	44	19.0	3	1.4	1	0.4	1	0.4	2	0.8
B past.	370	7	1.9	111	30.0	102	27.5	112	30.3	19	5.1	19	5.1

the counts of poor quality milk. Our own results as a general rule do not confirm this finding. They show that all of the counts are increased, those for raw milk almost doubled, while those for pasteurized increase by about one to one-and-one-half times. The increase in counts on the new agar places more samples of Grade B milk than of Grade A in the category of exceeding the limits permitted by the code. Whether a ratio of counts is proper for a comparison of the two media is a matter of question since the additional organisms which grow on the new media may bear no relationship to the ones which grow on the old. In such a case a ratio would be misleading and the absolute increase on the new medium would be the only figure of significance. It may be noted that the absolute increases for Grade A are small as compared to the increases in counts of Grade B milk when passing from the old to the new medium. It would seem probable that the organisms which grow in the new medium but not on the old, require milk or milk derivatives for growth. The new medium supplies these materials. The peculiar need of the organisms for milk is demonstrated in the higher counts on the new medium as compared with those on blood agar (compare Tables 5 and 8). For most organisms infusion blood agar would be considered more favorable to a maximum yield of colonies. The need for milk suggests that the organisms in question may come from poorly washed or inadequately sterilized equipment.

The fact that the two media produce such different pictures of bacterial content for the same milk emphasizes the arbitrary nature of any "Standard Methods count." This arbitrariness constitutes no objection to the use of such technic as one of the means of controlling a given milk supply, provided, of course, that a correlation has been established between the counts in question and the sanitary quality of the milk. In comparing two different kinds of milk, on the other hand, the Standard Methods count, while of primary importance, must be supplemented by other bacteriological studies if we are properly to evaluate differences in the two milks. As examples, we may mention (1) the kinds of organisms which constitute the flora counted on the plates, and (2) the kinds and numbers of organisms which do not grow on the Standard Methods agar, such as the anerobic spore-forming organisms.

THE MICROSCOPIC COUNT

The direct microscopic count (Table 9), which was done as a routine procedure for all milks received, constitutes a check on the plate methods, first, since the plate methods do not distinguish between colonies of organisms and individuals in the milk, and second, because organisms may be

TABLE 9

Distribution of Microscopic Counts Based on Counts of Individual Cells

	No. of Samples Totals	100,000 and Under		100,001–500,000		500,001–1,000,000		Over 1,000,000	
		No.	%	No.	%	No.	%	No.	%
A raw	185	84	45.4	67	36.2	13	7.1	21	11.3
B raw	326	41	12.6	161	49.4	54	16.6	70	21.4
	No. of Samples Totals	50,000 and Under		50,001–250,000		250,001–750,000		Over 750,000	
		No.	%	No.	%	No.	%	No.	%
A past.	231	141	61.0	50	21.6	23	10.0	17	7.4
B past.	366	104	28.4	142	38.8	90	24.6	30	8.2

present, which although capable of being stained have requirements for growth too fastidious for the medium upon which they are planted. An examination of Table 9 shows counts that are higher than those obtained by the plate methods, but indicates as definitely as do the plate counts, the predominance of lower counts among Grade A samples.

IDENTIFICATION OF ORGANISMS ISOLATED FROM AGAR PLATES

In order to determine the kinds of bacteria which constitute the flora of Grade A and Grade B milk, studies were made of organisms isolated from Standard Methods plates and blood agar plates. Two colonies from each were examined. Morphology, reaction to the Gram stain, and a few sugar reactions of the organisms were noted. With the help of these and reference to *Bergey's Manual of Determinative Bacteriology* (4th and 5th Editions), organisms wherever possible, were placed in their proper genera. Table 10 summarizes the findings.

TABLE 10

Organisms Isolated from Agar Plates

No. of Samples in Which Organism Was Found (Per cent in Parentheses)

	A Raw (Total 179 Samples)	B Raw (Total 341 Samples)	A Pasteurized (Total 227 Samples)	B Pasteurized (Total 372 Samples)
Staphylococcus and micrococcus	175 (97.7)	296 (87.8)	140 (61.7)	168 (45.1)
Streptococcus alpha hemolytic viridans	131 (73.0)	300 (87.9)	164 (72.2)	355 (95.5)
Bacillus	127 (70.8)	253 (74.2)	148 (65.0)	131 (35.2)
Streptococcus beta hemolytic	69 (38.5)	145 (42.5)	5 (2.2)	30 (8.1)
Escherichia	38 (21.2)	89 (26.4)	6 (2.7)	15 (4.0)
Aerobacter	31 (17.3)	93 (30.0)	0	7 (1.9)
Unclassified non-fermenting bacilli	6 (3.4)	13 (3.8)	1 (0.4)	4 (0.9)

Organisms Less Frequently Found

Alcaligenes—	6 (A raw),	6 (B raw),	1 (A past.),	5 (B past.)
Lactobacillus	1 "	—	16 "	15 "
Achromobacter	2 "	2 "	—	—
Flavobacteria	—	—	—	1 "
Chromobacter	—	1 "	—	1 "
Pseudomonas	2 "	8 "	—	—
Sarcina	3 "	7 "	34 "	23 "
Serratia	—	5 "	—	—
Proteus	6 "	5 "	—	—
Actinomyces	—	—	7 "	6 "

This tabulation does not show yeasts and molds which were grown on a special medium, the counts of which are reported in another section. Clostridia were also grown on a special medium, and the counts are given elsewhere (see Table 14). The coliform counts reported are those obtained in the routine examination of the plates described above. By the use of special media and larger inoculum, a much larger count was obtained. This will be discussed in reference to Table 12.

It will be noted that this study yielded no organism which can be said to be characteristic of Grade A or Grade B milk, although the frequency of occurrence of some of the organisms varied. Staphylococci and micrococci were isolated with greater regularity from Grade A than from Grade B milk, whereas the viridans streptococcus was somewhat more common to Grade B milk. Both organisms are inhabitants of the normal udder, although both types also occur in fecal material. Both organisms occur in sufficient numbers to survive pasteurization.

One group of organisms which is always under suspicion of being potentially pathogenic, the beta hemolytic streptococci, was further studied by means of the Lancefield precipitation test with the following results:

		Classification							
		Group A		*Group B*		*Group C*		*Other Groups*	
Grade	*No. of Samples*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
A	27	0	0	18	66.7	62	22.0	3	11
B	64	0	0	36	56.2	16	25.0	12	19

Of particular interest is the fact that group A, which includes the majority of the beta-streptococci of human origin, has no representatives, whereas group B, which contains organisms of bovine origin has the greatest number of strains for both Grade A and Grade B milks. Group C, which contains organisms some of which may be animal pathogens, yielded like percentages for both Grade A and Grade B milks. Our results agree with those of Carr as to group A but are reversed for the frequencies in groups B and C.

The other organisms in the list are for the most part inhabitants of air, water, soil, and manure. It is a matter of considerable interest that organisms of the commonly recognized intestinal pathogenic types, such as typhoid, paratyphoid, and dysentery, were never encountered in any of the raw or pasteurized milks. The "unclassified bacilli" in the table corresponded culturally to the genus *Brucella*, but did not agglutinate with anti-Brucella serum.

COUNTS ON VIOLET RED BILE AGAR (COLIFORM ORGANISMS)

A special study of coliform organisms (Table 11) was made using a quantitative method with agar plates prepared with violet red blood agar. On this medium coliform organisms produce red or pink colonies on 24 hour incubation at 37° C. In addition to coliform organisms certain Gram-positive bacilli produce red colonies which cannot be distinguished. While this introduces an error in the counts, these same organisms are called coliform if the Standard Methods presumptive test alone is applied. In most studies on milk the confirmatory tests are not done. Both pasteurized milks made a good showing, in that 93 per cent of Grade A and 81 per cent of Grade B

TABLE 11

Distribution of Coliform Counts (Violet Red Bile Agar Counts)

	Raw Milk				Pasteurized Milk				
	A Raw		B Raw			A Pasteurized		B Pasteurized	
Group	No.	%	No.	%	Group	No.	%	No.	%
0–10	18	10.0	0	0	0	215	93.0	308	81.5
11–100	41	22.8	12	3.5	1–10	11	4.8	55	14.6
101–1,000	64	35.5	72	21.1	11–100	5	2.1	11	2.85
1,001–10,000	46	25.6	172	50.5	101–1,000	0	0	4	1.05
Over 10,000	11	6.1	85	24.9	1,001–10,000	0	0	0	0
Total	180	100.0	341	100.0	Total	231	99.9	378	100.0

yielded 0 colonies per cc. None of the Grade A milks yielded above 1,000 colonies, whereas approximately 1 per cent of the Grade B milks fall into this group. In the raw milks, 10 per cent of the Grade A samples yielded 10 or fewer colonies per cc. None of the Grade B samples fell into this category. At the other extreme, in the group of "over 10,000 per cc." were found 6.1 per cent of the Grade A samples and 24.9 per cent of the Grade B.

TABLE 12

Geometric Means of Violet Red Bile Agar Counts (Coliform Organisms)

Raw Milk by Months

Month	Grade A	Grade B
Apr., 1939	5	2,700
May	160	1,800
June	730	7,300
July	370	5,500
Aug.	3,800	17,000
Sept.	1,100	9,300
Oct.	300	2,800
Nov.	780	1,200
Dec.	100	1,700
Jan., 1940	60	2,900
Feb.	360	1,000
Mar.	240	2,100
Geometric mean of series	430	6,700

A study was made of the types of coliform organisms isolated from the milk agar and blood plates. Of these, approximately 8 per cent of the total isolated gave positive reactions for fecal types of the organisms. There was little difference in this respect between the two kinds of milk. The organisms increase in numbers in the milks during the hot months but the proportional rise in Grade B does not seem to be greater than in Grade A (Chart IV).

COUNTS OF CLOSTRIDIA (B. WELCHII) SPORES

Another intestinal group commonly found in milk is *Clostridium*,* often referred to as *B. welchii*. The presence of this organism was determined quantitatively by using 50 cc. of milk, previously heated to 80° C. for 10 minutes, inoculated into 50 cc. of Wilson-Blair agar in Kolle flasks. The organism in this medium gives rise to large, intensely black colonies. It will be noted that the count is not of vegetative cells but of spores. That the organisms as found in milk are largely in the spore form was indicated by a number of tests in which heated and unheated samples of the same milk were plated on the Wilson-Blair medium. The counts of black colonies for heated and unheated were substantially the same.

The results of the tests based on the procedure just given may be found in Tables 13 and 14. They show that Grade A milk is free of the organism 2 to 3 times more frequently than is Grade B. In the range of 1 to 5 colonies per 50 cc. the two are not very different, but the difference is large in

* *Bergey's Manual of Determinative Bacteriology* (5th ed.), 1939, p. 772.

the group of milks which produce more than 5 colonies per 50 cc. About 1.3 per cent of the Grade A samples were in this classification as against 15 per cent of the Grade B. The organism is clearly resistant to pasteurization.

tion. This is true especially since the organism does not grow in milk as long as free oxygen is present. Any organism found would therefore result from original contamination unless the conditions of handling were unusually bad.

TABLE 13

Distribution of Clostridia Counts

		Colonies per 50 cc. of Milk					
		0		*1–5*		*More than 5*	
	No. Samples Tested	*No.*	*%*	*No.*	*%*	*No.*	*%*
A raw	184	73	39.7	106	57.7	5	2.6
B raw	333	47	14.1	219	65.5	67	20.4
A pasteurized	219	104	47.6	114	52.4	1	0.05
B pasteurized	344	71	20.6	237	69.0	36	10.4

The distribution of counts by months reveals a seasonal variation in the numbers of clostridia present, as may be seen from Chart III.

It would appear that the organisms start to increase in both milks in July. A striking difference appears, however, in December where the Grade A counts decrease and the Grade B counts continue to rise until March.

Clostridium perfringens is so commonly found in fecal material that the extent of its occurrence in milk would seem to be one of the best available methods of calculating manurial pollu-

TABLE 14

Average Clostridia Spore Counts per 50 cc. for Each Grade by Months

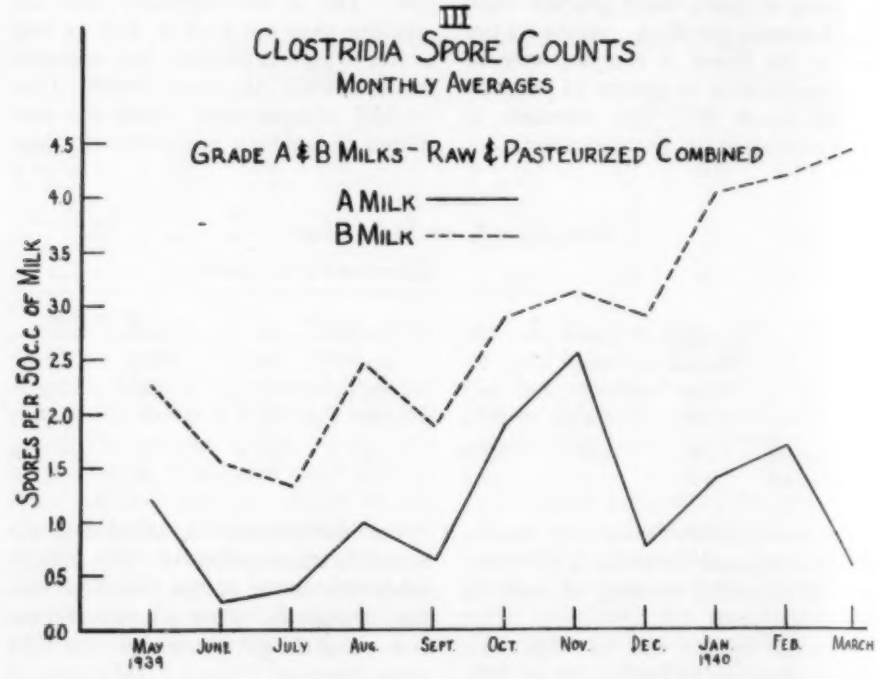
Month	*Grade A*	*Grade B*
May	1.2	2.3
June	0.3	1.53
July	0.38	1.34
Aug.	1.0	2.44
Sept.	0.63	1.9
Oct.	1.9	2.9
Nov.	2.53	3.1
Dec.	0.73	2.9
Jan.	1.4	4.04
Feb.	1.66	4.2
Mar.	0.56	4.3
Average	1.24	2.94

For the purpose of calculating the actual contamination of the milk a study was made of the clostridia content of manure. Four samples of fresh cow manure gave average clostridia spore counts of 500 and 2,000 organisms (spores) per gm. of wet and dry material respectively. Therefore, each organism represents on the average 0.002 gm. of wet manure and 0.0005 gm. dry. Since a total of 510 colonies were obtained from 20,500 cc. of Grade A milk tested, it follows that there were approximately 25 spores or 0.05 gm. of manure per qt. (0.01 gm. dry). With a production of 1,000,000 qt. per day, 50,000 gm. or 111 lbs. of fresh manure are brought into the city per day in Grade A milk. From 34,400 cc. of Grade B milk, 2,017 clostridia colonies were isolated. This is equivalent to 59 spores per qt., corresponding to 0.12 gm. of fresh manure. Per million quarts this would be 120,000 gm. or 267 lb. of fresh manure. At the present time about two-ninths of the milk supply labelled Grade B is actually produced on Grade A farms. If this correction were to be applied, 1,000,000 qts. of Grade B would, if derived only from Grade B farms, therefore, have a

III

CLOSTRIDIA SPORE COUNTS

MONTHLY AVERAGES



IV

VIOLET RED BILE AGAR COUNTS

MONTHLY GEOMETRIC MEANS

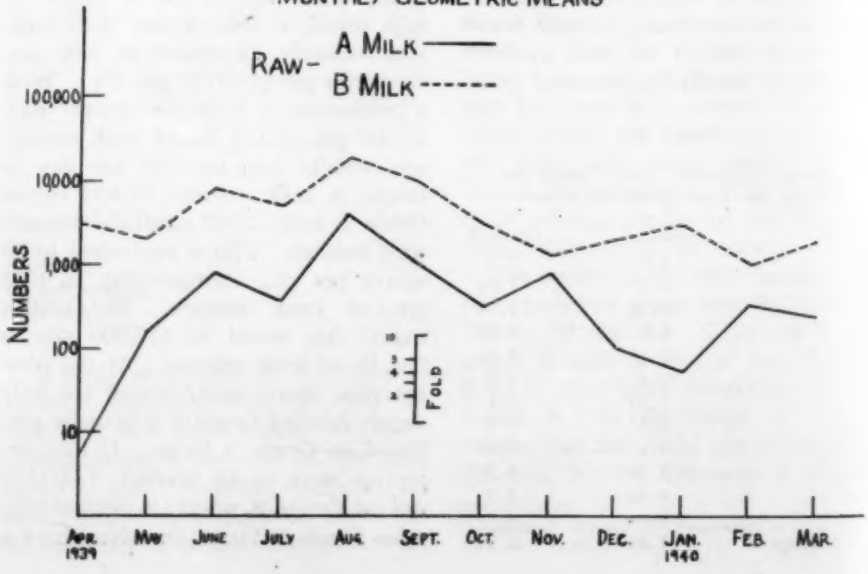


TABLE 15

Yeasts and Molds—Distribution of Counts Based on Counts in 0.1 cc. Samples of Milk

Grade	No. of Samples	Colonies: 0–100 No.	0–100 %	101–1,000 No.	101–1,000 %	Over 1,000 No.	Over 1,000 %
A raw	185	128	69.1	44	23.8	13	7.1
B raw	341	167	49.0	88	25.8	86	25.2

Grade	No. of Samples	Colonies: 0 No.	0 %	1–5 No.	1–5 %	Over 5 No.	Over 5 %
A pasteurized	231	149	64.5	68	29.4	14	6.1
B pasteurized	373	184	49.3	126	33.8	63	16.9

higher clostridia count which would correspond to 311 lbs. of manure for that volume of milk.

COUNTS ON SABOURAUD'S AGAR (YEASTS AND MOLDS)

Yeasts and molds were grown on Sabouraud's agar, which because of its high acidity prevents the growth of most bacterial forms. The results are presented in Tables 15 and 16. Incubation was for 4 days at 20° C. Portions of 0.1 cc. were plated on the agar, and the results are expressed on the basis of this volume.

From Table 15 it may be seen that lower counts predominate among Grade A raw samples, whereas in the high grouping (over 1,000 per 0.1 cc.) are found 25 per cent of the Grade B raw samples, and only 7 per cent of the Grade A.

Pasteurization destroys a very large percentage of the yeasts and molds, so that the counts are very much lower in samples which have been heated. Again the distribution in the low range, however, is proportionately about the same as in the raw milk and in the high range (in this case over 5 per 0.1 cc.)

TABLE 16

Geometric Means of Sabouraud Agar Counts (Yeasts and Molds) Raw Milks by Months (0.1 cc. Samples)

Months	Grade A: Total	Grade A: Molds	Grade B: Total	Grade B: Molds
Apr., 1939	...	...	500	....
May	700	5.8	3,400	0.14
June	550	1.2	3,300	0.17
July	110	0.	4,300	0.26
Aug.	49	2.5	360	1.3
Sept.	43	0.	54	3.6
Oct.	30	6.2	60	9.3
Nov.	34	2.6	51	3.0
Dec.	25	5.6	68	1.9
Jan., 1940	49	3.6	71	2.0
Feb.	37	4.6	78	0.93
Mar.	25	4.3	80	3.2
Geometric mean of series	66	2.9	240	1.2

are found almost 17 per cent of Grade B samples as compared with 6 per cent of Grade A.

In Table 16, the geometric means of the monthly counts are given together with the means of the counts of molds alone. It may be noted that the yeasts far outnumbered the molds in both milks, and that the molds were more numerous in Grade A milks.

TOXICITY TEST

In view of the fact that a number of the older studies (Flügge,[3] Park and Holt [4]) had revealed a toxic property in bad milks which was not destroyed by pasteurization, it was thought of interest to determine whether any difference might be noted as between Grade A and Grade B milks in potential toxicity. As the easiest means of determining the presence or absence of such a property, the guinea pig was chosen as a test animal and the milks under examination were injected interperitoneally. Prior to injection, each milk was allowed to stand for 48 hours at room temperature and was then subjected to repasteurization. In the summer, room temperatures at times reached a high of 35° C. during parts of the day while during the autumn and winter months, room temperatures for the whole day and night varied slightly from 25° C. After injection, the guinea pigs were observed for 1 hour and at intervals for 3 days. Since the pigs which showed no symptoms were reused, there were occasionally instances of anaphylactic shock. Whenever such symptoms occurred, or whenever an animal became sick or died, the milk was retested on an unused pig. Unless the second test produced sickness or death, the result was recorded as negative. Symptoms of toxic effect were usually manifested in the course of a few hours. The guinea pig reacted in most cases by showing symptoms of illness—ruffled fur and lack of reaction to stimuli. This state would continue for at least 4 hours, when recovery would begin or the animal would gradually grow worse and die. Death usually occurred within 1 day after inoculation.

In Table 17 the results of the test are summarized.

Of 300 Grade A samples, raw and pasteurized, none produced symptoms of poisoning. Of 682 samples of Grade B, 20 animals became sick or died. The production of the toxic property was limited to the warmer weather. Of the 20 cases of animals affected, 2 occurred in April, 5 in May, 8 in June, 1 in July, 3 in August, 1 in October, and none in the rest of the months. During these months 346 samples of Grade B milk were examined, making the percentage of occurrence for the toxic property 5.8. There was no indication that pasteurized milk was better than raw in respect to the number of samples which produced toxic material.

The causative agent of the toxic

TABLE 17

Results of Toxicity Tests on Guinea Pigs

	No. of Milk Samples Tested	*No. Producing No Toxic Symptoms*	*No. Producing Toxic Symptoms*	*No. Killing Animals*
A raw	171	171	0	0
A pasteurized	228	228	0	0
Total for Grade A	399	399	0	0
B raw	316	308	7	1
B pasteurized	366	354	9	3
Total for Grade B	682	662	16	4

effect could not be discovered. The blood and organs of animals which succumbed yielded no organisms on aerobic and anaerobic cultivation which when recultured and reinoculated into animals produced any symptoms. It is probable that some heat-stable toxic material was formed which produced a chemical or toxin type of poisoning.

DISCUSSION OF RESULTS

In considering the results of the study, we may properly deal with the raw and pasteurized milks separately. The bacterial counts of various organisms in samples of raw milk measure the efficiency of the sanitary procedures used in its preparation. In pasteurized milks the counts measure the effectiveness of the same procedures but the pasteurization process, by killing off a certain percentage of the organisms present, has reduced the unit of measure by as much as 99 per cent or more (depending on the efficiency of pasteurization for the particular organisms in the milk). If the pasteurization is poorly conducted with inadequate heating temperatures or holding times, the count is influenced and therefore measures also the efficiency of pasteurization. Since the grading system deals essentially with different levels of *farm* sanitation, the quality of the raw milks, rather than that of the pasteurized, most effectively measures its accomplishments.

Each of the various counts made during the course of the investigation measures the effectiveness of one or more farm practices. If the farmer uses dirty utensils, allows dirt to fall into the milk, or maintains a dusty barn, the offense is recorded by the presence of bacteria in the milk. If the farmer is guilty of additional carelessness in allowing the milk to stand uncooled for any appreciable length of time, these bacteria grow and by their increased numbers leave a further record in the milk of its improper handling. The record is expressed numerically as the Standard Methods count. True, it does not enumerate all the bacteria present in a sample of milk, but it is generally accepted that the degree of sanitary carelessness and size of bacterial count are proportional. Also, since carelessness and the possibility of contamination with human pathogens go hand in hand, the size of the count measures in a rough way the degree of safety of a milk. From the results obtained with the raw milks, it would appear that the methods of the B Grade farmers were one-seventh as effective as those of the A Grade farmers in keeping out bacterial contamination (see Table 7). This estimate is approximately the same as that of the Carr study in which the average ratio of bacterial counts of Grade B to Grade A was 6 to 1, for milks just prior to pasteurization.

In addition to the lower counts of Grade A milks, it is noteworthy that they are also less variable in the range of their counts. This has been shown by the upper quartile test. The average ratios (upper quartile to median) for all Grade A milks being 1.7 as against 2.3 for Grade B milks.

While the Standard Methods count measures overall cleanliness and care in handling, other counts measure more specific practices. The count on yeasts and molds, for example, probably measures the cleanliness of utensils and the condition of the air in the barn. Yeasts and molds prefer an acid medium for growth and therefore probably do not grow to any great extent in milk. They would be expected to grow luxuriantly in poorly rinsed cans containing small quantities of soured milk. They would also grow on old wet manure or feed and either directly or through the air find their way into the milk. This would be particularly true of the molds. The fact that molds tend

to be slightly higher in Grade A milk is probably due to the widespread use by Grade A dairies of lime phosphate powders which tend to dry the floor of the barn and therefore increase dust in the air. On the basis of the total counts there is a threefold difference between Grade A and Grade B production favoring Grade A milk.

Pollution by manure may next be considered. It is measurable by two of the tests employed, the clostridia spore count and the coliform count. The first organism probably does not grow after it gets into milk, the second is capable of multiplication and grows on the Standard Methods medium. The first organism does not sporulate in the presence of sugar, so that if growth occurs, vegetative cells are produced which would be killed by the 10 minute heating at 80° C. to which the milk is subjected before it is plated on the medium used in our experiments. The conversion of spore to vegetative cell probably does not take place in milk under average conditions since the organism multiplies only in the absence of free oxygen. The clostridia spore count, therefore, in all probability is the best measure of manurial pollution uncomplicated by variations in temperature and time of holding prior to pasteurization. It should be remembered, however, that the contamination need not be a direct one but may come from organisms which have spent a period on dust particles in the air.

The results show three things of interest: (1) "Grade A technic" of milk production is 3 times more effective than the "B technic" in excluding the organism from samples tested under similar conditions. In the prevention of high counts the A technic is 8 times more efficient than the B. (2) The distribution curve of the organism throughout the year varies with the two milks. It appears that while there is a general tendency for an increase in number of clostridia in both milks from July to September, a difference develops during the month of October, Grade B milks continuing to increase in counts, whereas Grade A milks begin to decrease in clostridia during this month. This is in spite of the fact that the cattle are stabled from this period on under conditions much more favorable (crowding and dust) to the contamination of the milk by this organism. (3) The fact that the organism is approximately as frequent in pasteurized as in raw milk shows the ineffectiveness of pasteurization as a means of destroying the organism.

The question of the significance of *Clostridia perfringens* is one concerning which the opinion of bacteriologists is still sharply divided, as it has been for many years. Its widespread occurrence in fecal material is used as an argument by some as a proof that the organism is harmless. On the other hand, there is some evidence that at least one outbreak of intestinal disorder was associated with the presence of *Clostridia perfringens*.[5] Very suggestive also is the experience with the disease known as "scours" or lamb dysentery.[6,7] This disease attacks lambs up to the age of 10 days, and is transmitted by milk, in two epidemics of which the causal agent has been definitely shown to be a clostridia organism of a distinct type but one not easily differentiated from the common kinds by the usual laboratory procedures. While there is apparently no human analogy to this disease, its possibility of occurrence should merit caution in declaring the *Clostridia perfringens* a harmless organism.

Clostridia perfringens and the other spore-forming organisms which find their way into milk can be controlled only by sanitary procedures since, as we have pointed out, the spores of these organisms are hardly if at all affected by pasteurization. It must also be remembered that the presence or absence

of such organisms is not indicated by the Standard Methods count.

The toxicity test performed on guinea pigs as described above discloses a defect in control of contamination not present in the technic of Grade A production but which appears occasionally in the warmer months in the production of Grade B milk. The nature of this defect can only be surmised. Some particular type of organism may be responsible or the cause of the reaction may be due to a combination of circumstances such as the presence of a number of different types of organisms which act upon milk at warm temperatures. Whether or not the toxic property for guinea pigs, which is developed in some Grade B milks, has any significance for humans, and in particular whether it corresponds to the toxic property of Park and Holt mentioned above, cannot be determined from the data of our study. The test is presented solely as one which distinguishes Grade A supply from Grade B supply of milk.

Pasteurization can be defined as the process which diminishes by a percentage, differing for each kind of organism, the number of living bacteria present in a given sample of milk. For such organisms as are the causative agents of human disease the percentage of reduction is very great, so great, in fact, that the chance of finding a living survivor in any given quart of milk is negligible. At the other extreme, however, we find the spore-forming organisms which in the state of sporulation are so resistant to pasteurization that one may expect to find little if any reduction in the count of viable organisms after the milk has been through pasteurization. Between these extremes lie most of the other species of organisms which find their way into the raw milk, some more and some less resistant. Practically nothing is known of the resistance of viruses to pasteurization.

The fact that pasteurization causes a geometric or percentage reduction in the number of living organisms means that with the organisms most vulnerable to heat a number of living survivors could be found after pasteurization, provided initial contamination is high enough. Let us consider an example based upon experimental findings with dysentery bacilli.

Twenty-five cultures of dysentery organisms were kept at a temperature of 145°F. in milk for 10, 20, and 30 minutes. The average initial number at the start of heating was 600,000,000. At the end of 10 minutes there were on the average 5,000 survivors, at the end of 20 minutes there were 600, and after 30 minutes no survivors. The average rate of reduction could be expressed by the ratio of $\frac{10,000}{1}$ for a 10 minute period of heating. For a 30 minute heating this becomes $\frac{1 \times 10^{12}}{1}$. If all the allowable count for Grade B raw milk (750,000) were made up of dysentery organisms there would be left after pasteurization $\frac{750,000}{1,000,000,000,000}$ organisms per cc., or one living survivor in every 1,300,000 cc. of milk. This is equivalent to one survivor per 1,300 qts., or the equivalent of approximately 300 contaminated quarts for the total city supply. A fully grown culture of dysentery organisms would leave possibly infective about 5,000 times this volume of milk. Under actual conditions, however, the number of dysentery organisms in the raw milk supply would be much less than either of the figures given, and one might expect to find few contaminated quarts of milk in the whole city supply in a period of a month or longer. The calculations show, however, that pasteurization, while a protective measure of considerable strength, is capable of being overtaxed by high initial pollution.

Throughout this paper there are a number of indications of the reduction in number of bacteria and other organisms, rather than of their complete elimination. Thus the ratios of the geometric mean counts of raw and pasteurized milk given in Table 6 show that on the average 2.1 per cent of the organisms survive for Grade A milks, and 5.3 for Grade B. The killing action of pasteurization is partly selective, but reference to Table 10 shows that in the main we are dealing with a percentage reduction since the same kinds of organisms are found in pasteurized milks as are present in raw. Yeasts and molds show a similar percentage reduction due to pasteurization. In Table 11 the distribution of counts of raw and pasteurized milks is about the same except that in the raw samples the counts are about 100 times greater. A similar picture is presented by coliform organisms except that in this case pasteurization leaves 10 per cent or less of the numbers of organisms originally present. Pasteurization therefore, while an essential safeguard for the safety of the milk supply is, as we have pointed out above, only a partial correction for defects in farm sanitation.

CONCLUSIONS

1. Agar plate counts of Grade A milk, by Standard Methods, gave monthly median values ranging from 22,000 to 300,000 for the raw, and from 450 to 2,400 for the pasteurized product. The range of Grade B milks, by the same methods, was from 160,000 to 890,000 for the raw, and 8,400 to 21,000 for the pasteurized. Use of the newly adopted official agar raised the counts of most samples of milk and increased considerably the number of samples of Grade B milk with counts in excess of the limit allowed by the present Sanitary Code of New York City.

2. The distribution of counts for each kind of milk shows that Grade A milk is a more uniform and cleaner product than Grade B milk.

3. Pasteurization appears to produce a greater reduction in the numbers of living organisms in Grade A milk than in Grade B.

4. The bacterial flora of both grades of milk is qualitatively much the same. The predominating organisms are streptococci of the viridans type and staphylococci.

5. Bacteria of the coliform group are significantly more numerous in Grade B raw milk than in Grade A raw. Bacteria of this type are much less numerous in both grades of pasteurized milks, samples of Grade B milk showing somewhat higher counts than do samples of Grade A.

6. Spores of the anaerobe *Clostridia perfringens* are more frequently found in Grade B than in Grade A milk. As the organism in the spore stage is not much affected by pasteurization, little difference was noted between the occurrence of these bacteria in the raw and the pasteurized milks of both grades.

7. Yeasts are much more numerous in Grade B raw milk than in Grade A raw. Molds are more numerous in Grade A milks. In the pasteurized milks, both counts are low and do not appear to be significantly different.

8. In a small number of instances samples of Grade B milk, allowed to stand for 2 days at room temperature, developed a toxic property not affected by repasteurization. The toxic effects could be demonstrated by interperitoneal injections of the milks into guinea pigs. This property did not develop in samples of Grade A milks similarly treated.

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CANNED FOODS AS SOURCES OF THE ESSENTIAL NUTRIENTS

● Early in this century, the existence of "accessory food factors"—the vitamins—was demonstrated by animal experiments (1, 2). Since that time, building upon information established by earlier investigators regarding the calorie, protein, and mineral needs of man, contemporary workers have developed a practical and fairly complete working knowledge of nutrition. At the present time, the fundamental human dietary requirements are considered in terms of some thirty substances of known chemical composition plus a number of factors whose chemical natures still await determination (3). Likewise, the dietary values of foods also may be discussed in terms of these same essential nutrients.

Viewed from a physiological basis, nutritional failures appear to be conditioned either by consumption of a diet deficient with respect to certain of the essential food factors or to altered processes in metabolism which prevent the efficient absorption and utilization of foods (1). Failures of the latter type can be corrected only by elimination of the defects in metabolism, or by administration of nutrients by routes which permit utilization. However, the vast majority of nutritional failures are associated with the consumption of diets deficient with respect to essential food factors. In the following quotation, the facts regarding malnutrition resulting from faulty diet are concisely stated (1):

> "Three facts concerning nutritive failure are becoming increasingly obvious: first, that it does not come solely from lack of vitamins but from deficiency of proteins and minerals as well; in certain of the lower animals, it comes even from lack of fats; second, that in America it is seldom complete; and third, that it is not, as a rule, the expression of a single nutritive fault. More often it is partial in extent and multiple in nature, with a clinical picture that is correspondingly lacking in detail and hazy in outline."

Although nutritional diseases are manifestations of the prolonged consumption of diets deficient with respect to amino acids, minerals, and vitamins, students of the problem agree (2, 4, 5, 6) that elimination of malnutrition is primarily a problem of increasing the variety of foods regularly eaten. Special emphasis should be placed upon the judicious consumption of familiar foods such as meats, (including glandular organs, poultry, sea food, and fish); eggs; milk in its many forms; milk products; fruits and vegetables; legumes; and the whole cereals and their various products. Thus, in its practical application (7), nutrition may be viewed as "an economic, agricultural, industrial and commercial problem, as well as a problem in physiology."

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